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COMPENSATION FOR CARRYING THE MAILS

The railroad companies have struggled hard, and are still so engaged to secure adequate allowances for handling the parcel post business and the mails in general. Needless to say, the parcel post feature of the government mail service has called upon the railroads to furnish increased facilities and extra accommodations at great expense without compensation, thus far, to cover the outlay. This has brought about substantial losses by reason of business, diverted from the express companies, to the postoffice department.

It has been most unfortunate for the railroads. Now, to secure complete justice prompt action on the part of Congress must be added to these efforts on the part of the common carriers. The railroads nowadays are certainly shouldering unjust burdens in more ways than one and the demands of the postoffice department may be characterized as almost the heaviest. That well known organization, the Railway Business Association, is going about the matter in the right way and in the end should succeed. In ten years, according to a recent bulletin issued by the Association, postoffice receipts have increased over one hundred per cent.; but payment to the railroads for carrying the mails in the same time increased less than twenty-eight per cent. It rightfully concludes:

"Mail pay ought to be adjusted according to some fair standard fairly applied.

"Mail pay ought not to be affected by the Postoffice Department balance sheet; the roads should receive not what the department is willing to pay them, but what the service is worth.

"Congress should lay down for guidance of the administrators of the law the rule that compensation shall be equivalent to what private shippers would pay for similar service.

"Fixing of rates and measurement of service to be paid for at those rates under the statute should be subject to review by some government body not directly interested in showing a surplus for the Postoffice Department.

"Amount of railway service to be paid for should be determined by measurement of actual service performed over a test period, never by arbitrary estimate not subject to check-up by the facts.

"Weight should be a factor as well as car miles and should be taken at least annually.

"Total mail pay for each road should be large enough to include fair compensation for every facility furnished and for every service rendered.

"The Postmaster-General is an interested party. He is judged by the departmental surplus or deficit. He should not, therefore, have final, arbitrary authority over matters in dispute between the railroads and his department.

"Payment to each road should vary according to length of haul, speed and frequency of mail train."

By a recent order issued by the Comptroller of the Currency, the transportation of moneys and securities between the U. S. Treasury and Sub-treasuries and the banks will hereafter be made by mail, registered and insured, instead of by express as heretofore. This calls upon the railroads, at present, to handle business without extra compensation, which, formerly going by express, was a source of substantial revenue to the railroads, under their existing contracts with the express companies.

Our sympathies and support are decidedly with the railroads and their efficient ally, the Railway Business Association. We look for a fair, honest adjustment of the whole matter which is so important and far reaching.

MECHANICAL OMNISCIENCE

It was stated by the Pennsylvania Railroad last month, that they had made about 2,000,000 efficiency tests of all kinds, and that the men on the road had responded. The record showed that 99.9 per cent. of them had lived up to the letter of the rules, and that only a fragmental fraction of the men had disobeyed. This figure approximates very closely to perfection pure and simple. Yet laying aside the effect on the report of the natural desire

to make a very good showing, which invariably colors even the purest motives, the result is most eminently satisfactory.

There were 28½ per cent. fewer employes killed in the first 6 mos. of 1915 than in the corresponding period last year. This was not due to a heavy decrease in train mileage, as passenger train miles were only 6 per cent. and freight train miles, 8 per cent. less than in 1914. The figure for employes killed in 1914 was 119 and in 1915 it was 85. No passenger was killed in a train accident in the period covered by these tests. This record has been clear since 1912.

A decrease in accidents is invariably accompanied by a high record of efficiency on the part of all employes, as shown in the tests which are made regularly on the P. R. R. These tests cover the work of both officers and the rank and file. The records for the first 6 mos. of this year show that 23,390 tests were made in the use of signals, and 99.4 per cent. of them showed employes living up to the strict letter of the rules. Over 10,000 tests were made with signals set at stop, and in only 13 cases did the trains fail to stop before passing the signal by so much as a foot.

The value of efficiency, as shown in the decrease of casualties is beyond price, but the way it was here accomplished was plain to see. One of the principles involved in 99 per cent. of the men obeying the rules lies in the fact that they practically act alike. Human beings can lay no claim to being omniscient, they are not "mind readers," yet it is the ability to predict, with reasonable certainty the probable action of others, which is one of the strongest points in the whole matter. The signal system with its home and distant semaphores has a sort of mechanical omniscience, as far as two blocks ahead are concerned, and this gives the system its value. Looking at the signals, one knows, without seeing the entire track, just what one will encounter as the train goes on.

The human factor is known to be exceedingly erratic in physical failure, in that it does not, and cannot be made, to fail always in one direction, as the signal system does, so as to produce delay and not disaster. When this same human factor, in cases where rapid and clear judgment are required,—rising often almost to the level of emergencies—can by observance of rule or by tacit consent, always do practically the same thing, one can reasonably predict the action. The element of high probability for safety is introduced and it is of the same quality that is the property of the signal system though in the human case it lacks the signal's mechanical accuracy.

This observance of rule is not a mere matter of safety to the individuals on a train or in a "tight" position on the road, though it acts in their favor. It is also a means of approaching safety by others who under the rules expect their fellows to act thus and so. Others make their calculations, based on the probability that a careful and conscientious man will obey the rule, and feeling reasonably sure that this estimate of a neighbor's action is correct, they act expecting that he too has in mind the responsibility which his previous good record has produced.

No man lives unto himself alone and nowhere is this more true than on a busy railroad at the present day. The man who cuts corners, shaves off time allowance or "tempts Providence" in various ways, as we say, is a Chancetaker, and this kind of man has no legitimate place on a railway to-day. He not only risks his own life and endangers those of his fellow-workers, but his action tends to break down the existing safeguard to others, built up by the predictable quality of good behavior.

In order to ascertain the reliability of conduct and to tabulate it for use in compiling figures for relative results a railway often resorts to what are known as "Surprise Tests." This is briefly the putting a signal in the "stop" position when there is no danger, and watching the result. Some think this kind of thing a form of "spying" on the men, and resent it accordingly. Others see in it the practice word of command that a soldier hears and respects.

It may be asked if the colonel of a regiment on parade may never call "halt," because no enemy is in the land? He orders the regiment to stop or advance, that in the army practice all may learn the meaning of the words, and all may work as one. An automatic cash register insures mechanical honesty when its drawer is closed, its bell rung, and it drops out the total of the various items to be paid for. No one feels aggrieved, for no one finds his good faith has been impuned, by the mechanical and faultless evidence of the sale.

We invite our readers of all ranks in railway service to consider the importance of the whole subject. Tests are not made merely to gain the applause of the public, by an adroit presentation of facts and figures which will make up in "display type" for the road's publicity department. It is above a mere self congratulatory flush of pride. It means the serious work of the road well done, by men who have to stop and think, and who intelligently go at a straight duty, however hard, with no thought of reward, but the sight of the warm and useful life of others around them, that they have helped to preserve, by action and example.

We invite our readers to give us the benefit of their views on the ethics of the Surprise Test. How do you view it? Is it right or is it wrong? Our columns are open to all those who, whether they agree with us, or whether we agree with them, will honestly state their convictions and beliefs. We want to arrive at a consensus of the best thought of the men who have to act bravely in arduous things. You think and act—we want to let the others know.

WHY THE RAILROADS MUST HAVE RELIEF

When the railroads in this country fell short $124,000,000 in their gross receipts for the year ending June 30 last, as compared with their revenues for the preceding year, it represented a tremendous shrinkage. And when the railroad managements busied themselves on lines of retrenchment to meet these awful decreases and reduced their operating expenses $138,000,000 it was a remarkable achievement.

When good times come again, and they seem to be approaching, the past experiences will be of great aid toward putting our great railroad systems into a condition of preparedness against another season of depression, which sooner or later is bound to recur. These ups and downs in business affairs are great teachers, exemplifying the idea that no one knows what he can do until he is obliged to do it.

But in spite of prospective good times, or an actual revival in business, the railroads must be allowed reasonable compensation for the services they perform. Increased taxes, the high cost of necessary materials and wage increases, with no compensating rate increases, are wearing the railroads out. Economies have, to a large extent, been effected to the detriment of equipment, roadbed and track. This carried too far, as we know, goes beyond the line of safety and is liable to lead to bad results. How long this can continue is a question, which, left to the industrious railway men, who are taxing their ingenuity to the utmost, will bring but one reply: "Not much longer."

The business man who will enjoy, in a large degree, this coming return to prosperity; the manufacturing concern whose revenues will be tremendously increased thereby, cannot consistently stand by and expect to gain honest rewards without bearing in mind that the railroads, too, should share in this long-looked-for good fortune. It seems absurd, beyond measure, when we consider it, how the manufacturer and others, advancing the prices of their products and readily selling them at the advance, object in the most forceful way at their command to the slighest increase in rates for hauling these wares to market.

It would seem quite in line with propriety that the railroads should be allowed some additional compensation for their interest in the transaction. When the railroads are not prosperous the people as a whole are unfortunately affected. Every man, woman and child in the United States is to a greater or less extent involved in a proper adjustment of matters which relate to the railroads. Let the railroads once enjoy prosperity and they are in the market on the largest scale for most everything produced in the country. This not only means work for everybody, but when all the manufacturing plants in the land are running full time and overtime every household in every city and hamlet from Maine to California is imbued with new life. When money is coming in cheerfulness is abroad.

Upon railroad securities, too, the whole population is more or less dependent. The wealth of the millionaire and the hard earned savings of the less pretentious captain of industry are here and there directly and indirectly invested in the bonds, stocks and other obligations which have been issued by the railroad companies for their maintenance and general improvement. One's savings laid away in the bank owe their security, perhaps, to the value of the railroad bonds or other obligations in which the bank managers have invested their reserves. These great national institutions—the railroads—must therefore not only be protected, but the needed relief must be provided now. None will appreciate this more than the rank and file of the vast army of railroad employes, whose whole interest and that of their families lie in the success of the railroad companies which furnish them employment.

TIE RENEWALS

Granting that the purpose of tie renewals is to maintain adequate rail support in spite of the deterioration in ties, it is legitimate to inquire by what method this purpose may best be accomplished. There are indications that present methods are not entirely satisfactory in the recurring experiments on metal and concrete ties and even in the partial use of tie plates and screw spikes.

The average practice in tie renewals seems to be to watch track for the appearance of ties that have failed and each spring to renew these ties. The claims made for this system are that all ties in the track are of an average degree of soundness—meaning that ties of all qualities, from new to nearly poor enough to be discarded, are at all times present in the track, and their average would represent ties in good serviceable condition. No account is taken of the fact that the single tie renewal method results in a continuous tampering with the ballast which may not be beneficial, or that a rail may be supported not by twenty ties of an average degree of soundness, but by three or four new ties, three or four old ties, and the balance varying between these extremes until the rail can hardly be considered to rest on ties of any one "average degree" of either soundness or unsoundness.

From this point of view another method of renewing ties is suggested, which has been tried to a small extent in this country and to a much greater extent on the continent. It consists in renewing ties in continuous stretches. Track is laid with carefully selected ties, and the practice is to disturb the ballast as little as possible except to maintain surface, line and gauge. The ties are all allowed to deteriorate together, until the whole stretch needs replacing. The advantages of this system would seem to be reduction in the amount of maintenance labor, less disturbance of ballast and foundation, more uniform quality of rail support, and possibly longer life of ties on account of less disturbance of ballast. At the time that it is decided to renew the whole continuous stretch of ties, the ties will be all in a poor condition to sustain traffic.

Some data as to the cost of maintenance by the continuous stretch method of tie renewal has been presented. One statement has been made that with the more even support for the rail, an 80-lb. rail will carry as heavy and as fast traffic as a 100-lb. rail with the more uneven support resulting from single tie renewal.

The columns of this magazine are open to our readers and any new light that can be directed toward this subject, or any records of cost of either system, where the accounts are sufficiently thorough to permit of accurate comparisons will be welcomed.

Steel Arch Over Hell Gate New York

The rather startling name applied to the narrow pass in the East River at New York began its career as a mild and quiet name. It comes from a Dutch word *Hellegate*, the translation of which is "bright strait" or "clear opening." The Anglicized form, which is somewhat similar in sound to the original name, was applied to the strait on account of whirlpools which made navigation at this point difficult if not actually dangerous.

Our line illustration shows in outline not only the general form of the bridge, but the erecting scheme as well. This bridge will be built out from each shore as a pair of cantilevers, but when completed it will be a huge, though graceful, arch sweeping over the turbulent waters, as a bow of steel. This bridge will have a four-track ballast floor with two sidewalks, one on either side, placed outside the line of the girders, and fully protected from the tracks of the New York Connecting Railroad and protected also on the river side for pedestrians.

The roadway or floor of the bridge is 135 ft. above the high water line, and this is approximately 50 ft. above the depth from the centre of the bearings to the centre line of the top chord is 260 ft. 2¾ ins. The tracks occupy something less than 60 ft., which is the distance horizontally between the centres of the trusses. The width of the bridge over all, including sidewalks, will be 90 ft. The approaches are deck plate girders with a total length of 5,500 ft. on this contract.

The estimated weight of the main span is 20,000 tons and that of the approaches is 25,000 tons. Thus the total estimated weight of the two approaches is 45,000 tons. These approaches stand on piers built of concrete and are split each into two legs, where they stand on the ground and joined in the upper portion by a masonry arch. The two stone and concrete abutments are massive, and though they stand considerably above the point of origin of the top chord and are really lofty, they are so solidly built, and so proportioned, that to the beholder they lose nothing of the staunch and weighty appearance which is their actual characteristic, while they are pleasing to the eye.

Bridge Material Weighing 150 Tons on Two P. R. R. Steel Flat Cars.

shore level. The span really rests on Long Island at one end and on Ward's Island at the other, and is a two-hinged, riveted through arch. Its length is 977 ft. 6 ins. measured from centre to centre of the bearings and

Each end of the lower chord is placed against the slooping side of the base of the abutment, and although the actual curve traced by the arch is that of a flat parabola, it appears as an arc of a circle. The bottom chord

is made tapered so that it is deeper at the haunches than at the crown of the arch, and though this has a direct engineering significance, it has the appearance of a bold and sweeping line shaded with the heavier stroke of an artist's touch. The ends of this chord terminate in a heavy steel ribbed casting tapered so as to present a hinge-like surface to the supporting casting which lies on the sloping base of the abutment at an angle of 45 degs.

This joining of the castings, with bearings and rockers to permit of a slight motion, but no slip, is the hinge upon which whatever motion there may be takes place, and at the same time they support the prodigious weight of arch, bridge, roadway and hangers. As a matter of fact the bridge fits closely between its supports, and the movement of the tightly-riveted arch, caused by the inevitable expansion and contraction due to hot and cold weather, shows itself as a slight rise at the highest point of the arch. The temperature changes in the length of the arch are therefore taken up in the bridge itself and produce a variation of internal stresses which have been duly provided for in the strain sheet. The upper chord is also "flexible" in the same way. The bridge floor hangs from the lower chord at the fourth panel from each abutment, and the slight rise and fall of the curve of the chords at the centre makes very little change in the level of the floor.

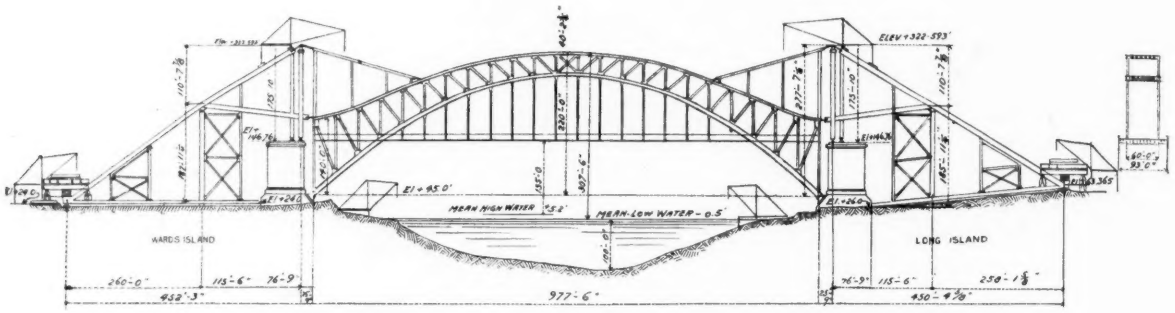
The lower chord passes below the floor level at the fourth post from the abutments and sinks down approximately 88 ft. to the hinge, while the top chord is about 50 ft. above the roadway. One of our illustrations shows perhaps the heaviest single piece of bridge material ever transported over the railways in this country. The piece of riveted steel plate is one end of the lower chord where it is placed against the hinge-joint. It weighs about 150 tons, as shipped, and occupies space on two specially constructed Pennsylvania Railroad cars. There being eight axles under the two cars, the load on each axle is about 18½ tons, or 9¼ tons to a wheel. The height of this bridge "arch-foot" was such as to exceed the P. R. R. load line on the direct road, so that in order to bring the cars to New York they were detoured over lines where the load gauge was higher than on the main line, and a "long haul" was therefore imposed on this bridge member by reason of its size.

Abutment on Long Island, Hell Gate Bridge, N. Y., Showing Foot of Arch and Temporary Back Stay.

The erecting scheme presents many interesting features. One of them that we have mentioned is the fact that the bridge, although a self-supporting arch in its finished condition, has to be erected as a cantilever. Our line drawing shows the shore post in place close to the abutment whose base is about 80 ft. wide, parallel to the track. To the top of this shore post, or rather, we should say, posts, as there are two of them to each girder, a back stay has been temporarily attached, and this stay, fastened to the top chord at the fifth panel, is sloped

down to the ground about 450 ft. back of the abutment. This sloping back-stay, made of borrowed girders, is anchored to the ground by a mass of girders, about 4,400 tons, taken, like the back-stay, for the time from the shore approaches.

In looking at our drawing the reader sees the outlines of the finished bridge but in the course of construction the centre panels go in last, to join the structure which stretches out its arms from each shore. As the bridge grows post by post, and panel by panel, there must come a time when the weight of nearly 500 ft. of girder will rest against the abutments and pull upon the anchored stays. At the top of each pair of shore posts

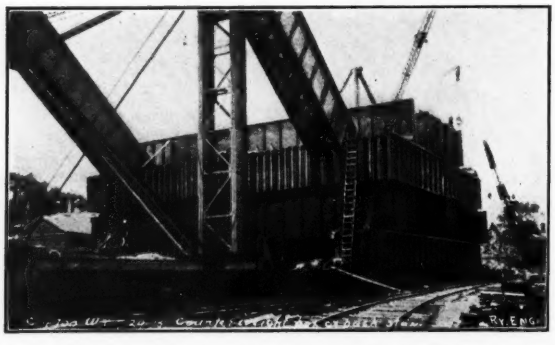


Outline of Hell Gate Bridge for the N. Y. Connecting Railroad, Showing Erecting Scheme.

there is a large 2,400 tons' capacity jack placed below the saddle of the upper or tension back-stay.

These enormous hydraulic jacks are intended to facilitate the placing and adjustment of what may be called the "keystone" panel of the arch. The girders fit tightly together and are riveted up, so that the final act of "placing" must be done with exceeding exactness. The pull on the back-stay is so arranged as to keep the open ends of the girders high, and at the appropriate time it will be necessary to lower them to make an exact fit with the last members to go in.

These jacks have been made at considerable expense,



Counterweight on End of Temporary Backstay.

and the use of the customary sand box has been discarded, because in slowly lowering the free ends of the girders the sand, while it might produce the desired sinking of level, has no means of lifting the girders, if by accident they sagged even the fraction of an inch below the critical level. The hydraulic jack, however, possesses the possibility of a lift, if that was found to be necessary, and there being one for each end of a girder, or four in all, a slight sag on one side and not on the other could readily be taken care of by the jacks.

The work of building, and erecting this collossal engineering work is in the hands of the American Bridge Company and the design, as shown by their drawings, not only presents a graceful but enduring structure, which is clearly most necessary for the population of a large part of the greater city, but it will have a distinctly artistic value in the environs of New York.

INTERNATIONAL ENGINEERING CONGRESS

It is thought that the engineering profession does not fully realize just how much technical and professional value the International Engineering Congress has to offer to its members. With the assistance of local representatives of the leading technical journals of the United States a more active advertising campaign has been started. Advertising matter may be had containing full information about the Congress and the transactions which will be published, together with a programme of the sessions of the Congress giving the titles of the papers and the names and titles of their authors.

The International Engineering Congress is a serious effort on the part of the five societies under whose auspices it is conducted, to give to the profession something of professional value in the shape of a clear statement of present practice in all branches of engineering in the different countries of the world.

While the war and the resulting conditions, even in neutral countries, have greatly reduced the enrollment of members, the war has not produced a proportionate reduction in either the quality or the quantity of the material for publication in the transactions. Sufficient papers have already been received to assure the success of the Congress; but in order that the Congress should be the greatest benefit to the profession, it is essential that it should enroll the greatest possible number of members. It meets this year in San Francisco, Cal.

The five engineering societies joining to carry on the 1915 International Engineering Congress, to be held September 20-25, are the Am. Soc. C. E., the Am. Soc. Mech. Engineers, the Am. Inst. Mining Engineers, the Am. Inst. of Elec. Engineers, and the Soc. N. A. & M. E. The executive offices are at the Foxcroft Building, San Francisco, Cal.

The terminal of the Baltimore & Ohio Railroad at Chillicothe, Ohio, has been equipped with a modern system of fire protection. Water has been piped through the yards, station buildings and shops in accordance with the policy of the company of taking every precaution to prevent the destruction of its property and the loss of shipments by fire. The railroad employes at Chillicothe have been organized into emergency fire companies, as has been at most of the large terminals of the road.

A MODEL RAILROAD

Patrons of a railroad, especially those who travel daily, are naturally interested in good service. This calls for "*safety first,*" supported by convenient trains, and polite officials. In large communities this is most essential. We have in mind as an example of railroad efficiency the New York, Westchester & Boston line. In its construction nothing seems to have been overlooked to make it safe and in its operation its service is complete. At great cost provision has been made not only to protect its patrons but every known safeguard is employed to protect the public generally. All highway crossings throughout the system are either over or under the tracks and there is little opportunity, if any, for the individual who seeks to tramp his way to destination to find an entrance to the right of way. The signal system is as perfect as present-day ingenuity permits; the cars are commodious and comfortable; the trains frequent and regular, and the trainmen seem to have been well instructed in the matter of cleanliness and politeness.

While this road has been the subject of much criticism because of the tremendous cost of construction and the manner of its acquisition by the New Haven System, it will in time outlive these criticisms and become, without doubt, a most valuable asset to the New Haven Railroad Company. Its one great secret of success lies in the fact that it is providing facilities well in advance of actual requirements; but the country through which the line runs warrants this. Its development for residential purposes is therefore rapid and no station is neglected looking to this end. In the old days parsimonious railroad managements expected business to come without invitation in the way of advanced facilities and many a property has failed miserably for this reason. It is a great achievement for a railroad to provide a reliable ticket system which will serve its own purpose as well as that of its patrons. There is no opportunity in this regard on the New York, Westchester & Boston for a patron, if dishonestly inclined, to accomplish his object and be he honest or otherwise he cannot board a train after it has started nor can he alight from it until the train has come to a full stop. This arrangement guarantees an extremely small personal injury account and few roads, as we know, are safe from enormous expenditures in this direction every year. Furthermore, every passenger is registered by a turnstile before he can pass out to his train. Civility costs little, but the gains from it are very large. Based upon civility alone many a railroad has become prosperous. It is a great quality and the Westchester management seems to have instilled this into every employee.

By a recent report the N. Y., Westchester & Boston seems to be gradually working its way out of deep financial shadows and its popularity and revenues are steadily increasing. Patrons might safely set their watches by the train service, which, by the way has been worked out most ingeniously, so that whether the traveller is bound for New Rochelle or White Plains he is dovetailed into a combination which insures him a direct and continuous journey. He arrives at the New York terminus under a similar provision. The substantially built stations, the perfect road bed and tracks and excellent equipment make for a maintenance cost very inconsiderable for a long time to come. Dwellers in and about New York are growing to be an up and down stairs community. Patrons of the New York, Westchester & Boston especially so, but the inconvenience of going up and down stairs soon becomes absorbed, if one considers the safety involved in the method and it soon fails to be a bugbear. Outgoing and incoming platforms are thus separated so that crossing the tracks at stations at grade is out of the question, while the passage to and from trains is accomplished without danger. The New York, Westchester & Boston fills a decided need and in spite of a troublesome beginning it bids fair to become in the end a financial success with a patronage devoted to it by reason of the more than suitable facilities which are extended.

PROMOTION IN RAILROAD SERVICE

There have been a good many ideas expressed at different times on the subject of promotion. Going over a railroad system, on one occasion some years ago an official of the Company remarked to a friend as the "Special" was running over a division which was rudely enclosed by an old fashioned rail fence:—"the line of promotion on this road is as straight as that fence." It was not difficult to understand the comparison. The speaker had evidently had more than one occasion, during his connection with the property, to observe the zig zag method of advancement in vogue. In his own case he had practically reached the top, after long service, and it appeared to be "up to him," as the expression goes, to be of material aid in changing the method, if possible. And this might have required more than ordinary acumen, in view of some facts. As a rule the man who is looking for promotion, all the time, devotes so much attention to this ambition that he fails to perform his duties to the best advantage. In his effort to secure promotion he fails to put himself properly in the way of it and the rail fence method is bound to govern in his case. Some one else lower down is perhaps selected, finally, for the position he expected to get.

Seeking the place of another who is doing his work well, or even badly for that matter, is, without doubt, the longest route to select in order to reach destination. It is so full of hazards that serious disaster is liable to be presented before one's journey is over. If he does not lose all his friends he finds himself in a very embarrassing position and may find ample cause for regret on account of his indiscretion. The rail fence method may not look so much out of line, after all, from some points of view.

It is safe to assume that every one—if he lives long enough—will sooner or later find his level. It may be high—mediocre or low, depending entirely upon the measure of his ability. It is seldom that we find a man in a top position, who remains there long, unless some special aptitude or qualification warrants it. The meteor flashes for a moment and is gone, while the fixed star occupies its place in the sky, night after night, forever. There is probably no field of occupation which offers so many opportunities for advancement as the railroad business; but as a rule, it is a long journey to the top. It calls upon a man who has selected this profession as his life's work, to exercise patience and perseverance to the utmost. He enlists for the war, so to speak and must fight his way persistently along to the finish.

Many unfortunate cases have arisen wherby a change in railroad ownership followed by a new management has forced an absolutely competent man to retire in favor of other talent. It may have found him, *out in the world* for a time, possibly; but eventually he has secured a position equally as good, if not better, than the one he was obliged to abandon. Wall Street has frequently been responsible for an overnight change in a railroad management which has brought grief to many a capable official. This has been especially true on the smaller roads. It was a wise but suddenly made incumbent of a high executive

position who declared: "I have no friends to support at the expense of this management." He retained every man on the road who was willing to do his best and exercise a loyal spirit. Promotions came as they should. Every man stood as good a chance as his neighbor, on his way up; but he had to work hard. There is some fairly substantial foundation then for the rail fence method, if it be viewed rightly.

The head of every department is bound to select what in his judgment is the best talent. He cannot afford to surround himself with incompetent friends. He is responsible for results and for his own standing must pick for his assistants the ablest men at his command.

The one who puts himself in the other man's place *in mind only*, realizes then, how the other man feels when either justice or an injustice happens to be introduced. True merit will regard the rail-fence method as an inducement rather than a detriment to his progress. The unjustly promoted friend soon finds his opportunities scarce. It is only a question of time when he fails to meet every requirement. The man behind soon replaces him. To adopt a strictly civil service method is out of the question. A selection of eligible men at the outset is the fundamental requirement. Each one then advances according to his worth and no man ought to know his worth better than the individual himself. In setting a value on his own capabilities, however, it is wise for one to underestimate rather than overestimate. An overestimate forces the impropriety of the rail fence method to obsess his mind; makes him an undesirable co-employe and an incompetent assistant.

Some men are good half way up; but are failures the other half, which ends at the top. Some men can stand prosperity all the time and others will fall down at the slightest vision of it. It was an all wise Providence and no one else who established the rule that merit in the end always finds its reward. Some men die before the reward comes; but they get credit for it just the same. Those who are born great; those who achieve it and those who have it thrust upon them, sooner or later find the respective niches in life for which they were intended, in spite of opportunity.

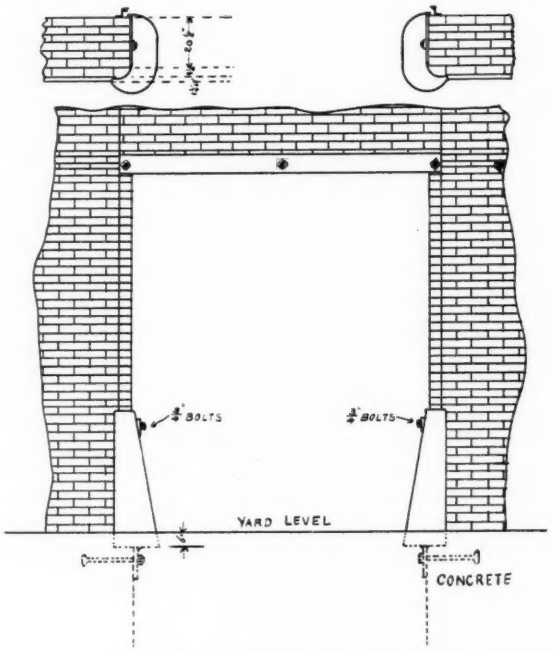
A very successful railroad man who owed his success to great genius and capacity was greeted once, after a long intermission of years, by an old school boy friend, who was still creeping along on the bottom: "Hello! they tell me you're running a railroad out West and are drawing $60,000 a year salary. Say, it beats all what cheek and circumstances will do for a man." The old school boy friend was the sort who would always be advanced, if at all, by the rail fence method. He could see no merit or virtue in any body or anything. Promotions come, oftentimes, slowly, very slowly; but the right man is bound to win at last. The man in overalls who applies himself rightly has as good a chance in these days to be president of the road as any other employe. Leaving the salary and place to one's superior; attending strictly to one's duties and making one's self useful are good suggestions to follow. Promotions will come with the certainty of a rising or a setting sun. Promotions for merit are common in these days. There is still room at the top and a good deal of room, too and there always will be. It is not a bad idea, if one thinks he belongs on top, to prove it by getting there and staying there.

Perfect taste is the faculty of receiving the greatest possible pleasure from those material sources which are attractive to our moral nature in its purity and perfection.—*Modern Painters.*

CORNER GUARDS FOR DOOR OPENINGS

By W. H. Wolfgang.

In the illustration is shown method of protecting brick and concrete on each side of door openings in factory buildings, warehouses, freight shed approaches or other similar places. There are many buildings where brick



Castings for Protecting Freight House Doors.

work around the doorways are badly damaged and look unsightly.

In the illustration is shown detail of cast iron guard for right side of door opening and the guard for the left side is similar. The guards can easily be applied after the buildings are erected as shown but it is better if they are applied when the building is in the process of erection.

For every living organism, says the *Dodge Idea*, there are just two states of existence, one is the state of growth and the other that of decay. Only the lifeless and inane remain stationary. For every organism the rule is either forward or backward. There must be either progress or retrogression. The weak and unfit must die and make room for the vigorous and growing. Indeed in the realms of life the strong and growing feed upon the decomposing organism of the weaker, and such, too, is the way in the world of business. If a business concern is strong and hearty, the story will be told in its growth. Otherwise, it has reached the state of decline and must soon topple over to become the stepping stones of an enterprise more full of growth. Despite occasional set-backs and panics, this is a land of growth. Business which has not moved forward in the last few years, is not keeping abreast with the times. If it is not growing, then it is high time to make it grow.

Art, devoted humbly and self-forgetfully to the clear statement and record of the facts of the universe, is always helpful and beneficent to mankind, full of comfort, strength, and salvation.—*Sesame and Lilies.*

WATER POCKETS IN WET CUTS

By E. L. Sinclair, Assistant Engineer, C. M. & St. P. Ry.

Referring to the article on water pockets and ditches in the July number of RAILWAY ENGINEERING, I have recently made some investigations of water pockets in wet cuts, and send you herewith a sketch showing how the soft yellow clay that pushed out from under the ballast sealed a clinker filled drain and a cinder filled trench over a drain tile holding the water in the bottom of the ballast.

In Missouri and Southern Iowa soft spots are found in cuts where the churning action of the track, when the ballast is saturated with water, works the sub-grade, next to the ballast, into a semi-fluid state, like grout and then pumps it out along the outside of the ballast when it forms an impervious side to the trench enclosing the ballast.

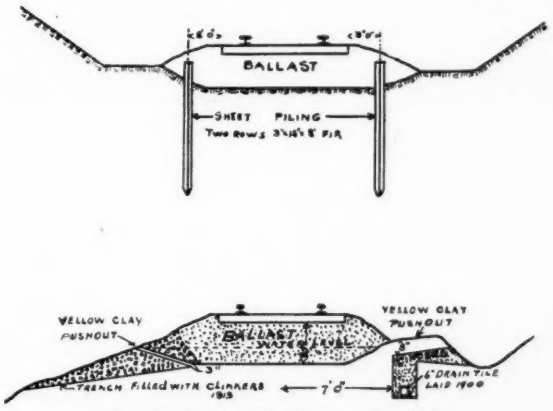
In this case the bottom of the ballast was saturated with water which quickly disappeared by way of the drain tile when the clay pushout between the ballast and the cinder-filled trench was removed.

The obvious remedy is to put in cross drains below the ballast in water pockets connecting them with the tile that is parallel with the track.

The cross drain should be supported by two pieces of plank in the form of a V and the trench filled with crushed rock, coarse cinders, or burned gumbo.

I have frequently found 4 to 6 ft. of ballast below the base of rail in water pockets in cuts in Missouri, and when such conditions exist, soundings should be made at the soft spots and a grade line established for bottom of tile trench low enough to provide drainage for the deepest water pockets.

Sheet piling made of two rows of 3 ins. x 12 ins. x 8 ft. plank driven on both sides of the track 2 ft. from end



"Pushout" of Yellow Clay in Rockbed.

of tie with top 1 ft. below base of rail, and then covered with ballast as shown in Fig. 2, has proved effective in stopping the material from pushing out from under the ballast, and when examined after six years' service was found not to have pushed out of line, and the trackmen report that it has been an easy matter to keep the track to surface and line, since the sheet piles were driven.

SOUTHERN INTERLOCKING PLANT

In addition to the automatic signals which the Southern Railway is installing in connection with the new double track line, a large interlocking plant will be erected at Charlottesville. The plant will be of the mechanical type with power. Home and distant signals will protect the crossing of Southern Railway and the Chesapeake & Ohio Railroad at this point. It will be provided with electric locks and annunciators to notify operators of approaching trains and will have a total of 48 levers. This plant will do much to facilitate the movement of trains on both roads through Charlottesville and it is of course arranged so that a collision will be a physical impossibility.

In connection with the double track work at Danville, Va., and in addition to the automatic signal system being installed, the Southern Railway there will be constructed a large mechanical interlocking plant to protect the crossing of the new main line of the Danville division with the Richmond division which will continue in use to serve the Danville freight terminal. The plant will provide for the operation of the connecting track switches and the switches at the end of the Richmond line and will be of the latest type. It will be provided with home and distant signals, electric locks and annunciators to notify operators. It will have a total of 40 levers.

CONCRETE FENCE CONSTRUCTION

In connection with the track depression work recently completed on the Sea Beach Line of the Brooklyn Rapid Transit System, nearly five miles of reinforced concrete fence have been built on the tops of retaining walls along the right-of-way.

The fences are 4 ft. 6 ins. high, consisting of 3-in. reinforced concrete slabs between concrete posts, spaced 8 ft. 4 ins. centers. The posts are reinforced with two ¾-in. twisted bars and four ¼-in. rods in the corners and are securely anchored to the retaining walls by the ¾-in. bars. All posts are 4 ft. 10 ins. high, with alternate posts 7 x 7 ins. and 7 x 9 ins. in section. At these latter expansion in the panels is provided for by 1¾ x 3-in. dovetail grooves.

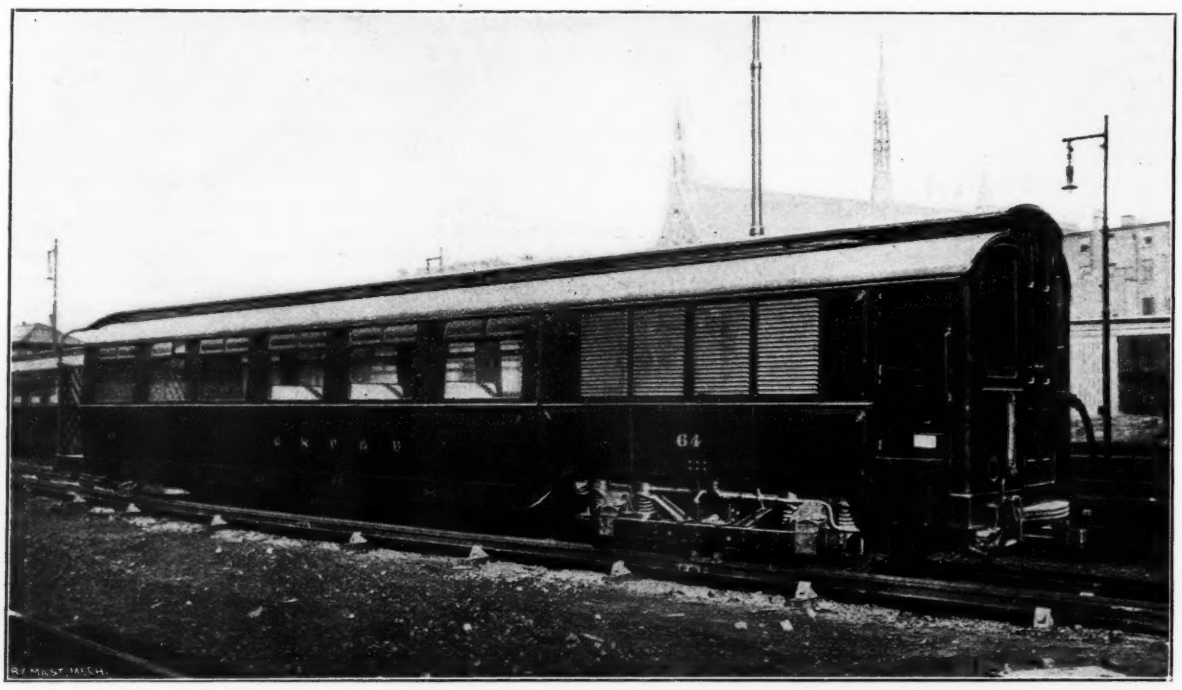
The posts were first cast, the panel reinforcing consisting of six ¼-in. horizontal bars and eleven ¼-in. verticals, being for the most part set before pouring the columns. A few days later the panels were cast in wood forms lined with sheets of galvanized steel, built so as to allow easy bracing and release. Concrete for posts and panels consisted of a 1:2:4 mixture with small pebbles as the coarse aggregate.—A. M. W.

LONGER SPANS—INCREASING LIVE LOADS

The rapid increase in live loads for railroad bridges has confronted the designers of long span structural steel bridges with a very difficult problem. The weight of the structure itself increases out of all proportions to an increase of the span, and if in addition the loads to be carried on the bridge are increased, then the members of the trusses, especially those in compression, become very bulky in weight and appearance, thus adding to the difficulties of erection. Lately the practice of using different kinds of alloy steel allowing higher unit stresses than the common structural grade, has resulted in the development of some highly interesting examples of bridges. Whether this practice will lead to greater economy over the use of structural steel remains to be seen. There is, however, no doubt that this method of using alloy steel permits the use of longer spans, and of increased live loads, wherever economy is not the only deciding factor. It will be instructive to watch the technical and as far as may be, the economical development of this new element in structural steel design, which must have considerable influence on some types of truss bridges, and on election methods.—*A. W. H.*

London Underground Railways

The London underground electric railways present several features quite different from those of the New York subway. In the first place the cars are smaller and the trains are not so long or so heavy, there being no "rush hour" traffic in one or even two directions as there is in New York. The trains consist of three or four cars and one car is set apart for smoking. Guards do not travel on all the cars and in some cases it is intended that the passengers shall open the doors.



Great Northern, Piccadilly and Brompton Motor Coach.

As a typical "tube," the Great Northern Piccadilly and Brompton Railway, commonly called the "Piccadilly," may be taken as an example. This road is leased in perpetuity to the Underground Electric Railway Company. The tube itself is 11 ft. 8¼ ins. in the clear and the tubular station measures 21 ft. 2½ ins. in the clear. The center line of the tube and the center line of the station are 3 ft. 3 ins. apart and this makes the circumference of tube and station almost coincide at the portion remote from the platform. One of the illustrations gives a cross section of station and tube, which shows this.

A feature of interest is the way the track is laid. A foundation of concrete is set in the center of the tube which is less in width than the total length of the ties. The result of this is that the ties which are set solidly in the concrete, overhang at the ends and the running rails are set upon the overhanging portion of the ties. The overhang is supported in a loose way by crushed granite cubes about ⅜ in. in size. This crushed granite is placed under the ends of the ties but is not tamped up solid, so that the support is comparatively soft, although the crushed granite and the tie are in contact. Thus the tie is held firmly in the center with ends more or less free under the running rails. This arrangement is intended to give a certain amount of springiness to the track and so enable the cars to travel over it with little or no shock or jar. The rails weigh 90 lbs. to the yard and are made of Bessemer steel. The lag screws which hold the "chairs" to the ties are prevented from making metallic contact with the chairs by vulcanized fiber bushings and washers. The chairs themselves, which hold the rails, rest upon pressed wood felt ¼ in. thick and this arrangement also gives a certain amount of spring to the track. The ties are made of Australian wood called Karri wood, which is non-inflammable.

The positive rail, or as we would say, the third rail, the one charged with electricity to drive the trains, is rectangular in section, placed 16 ins. outside the flange side of the left hand rail. This conductor rail, as it is called in London, weighs 85 lbs. per yard. The negative or return current rail is placed in the center of the track between the running rails. The drainage of the tunnel is effected by gutters across the track at various intervals. Very little water gets in, as the tunnels were driven through the London clay, which itself is impervious to moisture.

The passenger lifts or elevators are made by the Otis Elevator Company of America. Each lift can take about 70 passengers or a live load of about 4½ long tons—10,080 lbs. The depth of the tubes from the surface is about 70 ft.. At this depth the law holds that the subsoil is a kind of "no man's land." Expropriation is therefore unnecessary and the right to pass under any street or building is considered as free to the constructing company when the charter has been granted. The fact that no condemnation charges have to be paid does not destroy a property holder's right to recover damages, if his surface holdings are in any way undermined or otherwise endangered, or are likely to be. The road is of course built under official supervision. London's pet names for the tubes are short and to the point. The Baker Street and Waterloo line is commonly called the "Bakerloo."

After alighting from the lift at the bottom, the passen-

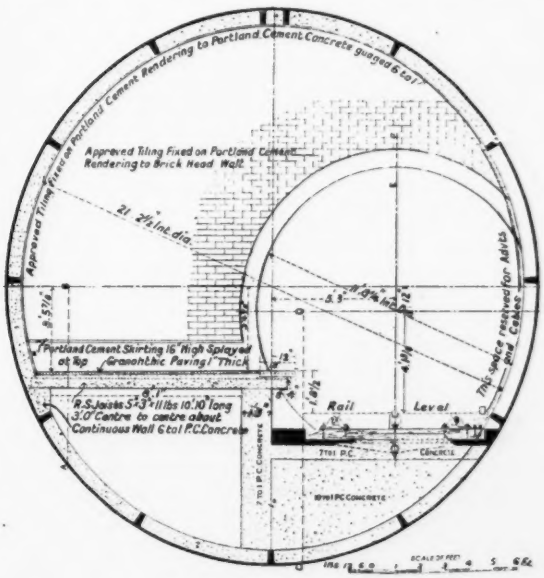
gers have a short stairway to descend in order to reach the platforms. Stairways to the surface are provided in case of accident to the lifts, of which there are usually four at each station. Another feature of the London tubes which appeals to the traveler is a very concise map, if one may so call it, of the line he may be on. A card

Tunnel at Holburn Junction: Piccadilly Tube.

is framed and hung two at each end of the cars, and being printed in large clear type may be easily read by those nearby. The same kind of "map" is also drawn with a horizontal line indicating the route, and is much enlarged, being about 6 ft. long. It is placed in the roof in the curved portion just below the clearstory, where the advertisements are arranged. There are four such maps in each car, and persons occupying the seats toward the center of the car and for quite a distance on each side, may easily follow the advance of the train and judge of their approach to their destination.

Many of the cars have a very neatly executed glass "map" painted black, with a green route line and red stations at connections with other lines. This map is made with two faces and can be seen by anyone in the car, as it occupies the space between two clearstory ventilators. This map is illuminated by electric lamps between the two glass plates, so as to be very distinctly seen. These maps, as we have called them, obviate the misunderstanding of names when called out by the guard and where they are not called out the passenger has still the means of knowing where he is on the line. This arrangement has been brought out by Mr. A. Rozier, mechanical engineer of the District Railway and Allied lines. It has been found most satisfactory to the public. Vertically arranged names and upright route line is used on the Piccadilly tube and horizontal route line is used in the cars of the City and South London Railway, and is the kind on the roof panels. A junction, say at Camden Town, makes a Y or fork on the map, the two ends of the fork terminating, respectively, at Golder's Green and Highgate. We are indebted to the courtesy of Mr. A. H. Stanley, managing director of the London Electric Railways, for the opportunity of making a study of the underground thoroughfares of the capital city of Great Britain.

The Fibro brake shoe is used on these lines: The

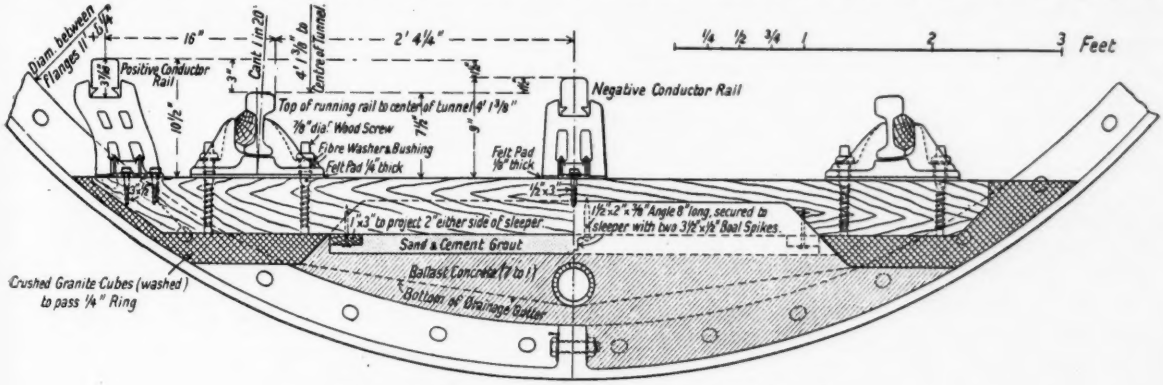

Approved Tiling Fixed on Portland Cement Rendering to Brick Head Wall
Portland Cement Skirting 6" High Splayed at Top
Granolithic Paving 1" Thick
Rail
Level

Cross Section of Tunnel.

shoe is made of peculiar fibrous material which has good holding power, does not wear the wheel treads to any extent, and has wear-resisting qualities itself.

TRACKS IN SUBWAY TUNNELS.

Some interesting facts were mentioned in our article on the Piccadilly Tube in London. The track there is laid so to be purposely "centre-bound" and free at the ends, to make the track springy. The subway tracks on this side of the water are laid in various ways, and in fact the experimenting is not over yet. The Interborough in New York was built for what they now consider very light traffic. It was opened on Oct. 27th, 1904, and was designed to carry 400,000 persons a day, with trains 2½


Positive Conductor Rail
Negative Conductor Rail
Top of running rail to centre of tunnel 9' 1⅜"
⅞" dia. Wood Screw
Fibre Washer & Bushing
Felt Pad ¼" thick
Felt Pad ⅛" thick
Sand & Cement Grout
Ballast Concrete (7 to 1)
Bottom of Drainage Gutter
Crushed Granite Cubes (washed) to pass ¼" Ring
Feet

Section Through Track and Lower Segment of Tunnel.

min. express headway and 3 min. on locals in the rush hours. In 1910 the traffic had doubled and now it is over a million a day, with 1 min. 48 sec. headway for expresses and 2 min. for locals in the rush hours. The weight of the cars is such that about 159,200 tons pass a given point in one day and the bulk of this is in the rush hours.

Mr. O. O. Dixon, Asst. Engr. of the Interborough, said at a recent N. Y. Club meeting that at first the ordinary steam railroad track was put in. The standard track now used is laid on 5 in. of ballast made of trap rock ¾ in., and screened clear of all material less than ¼ in. The ties are not "treated" and are long leaf yellow pine. The normal spacing of 22 in. centres, but this has been reduced to 18 ins. on curves. Guard rails are used on all curves less than 2500 ft. radius.

The guard rail was formerly a special section, rolled so that the base was parallel to the running rail, but the web is inclined toward the running rail so that the heads came close together and they were separated by the distance of the flange-way. Spacing pieces were used to keep them in place. As traffic increased this guard rail was found to be too flexible, as it transferred the thrust all too easily to the spacing-block bolts and spikes. The present form of guard rail is of the same section as the running rail, but has one flange sheared off, and a one-piece separator is put in to give correct flange-way. The inclination of the guard rail is thus done away with. The track on all curves above 500 ft. is standard width, 4 ft. 8½ ins. On curves of 200 ft. and up to 500 ft. the gauge is widened to 4 ft. 8¾ ins. and for curves having a less radius than 200 ft. the track is gauged to 4 ft. 9 ins. When this was done the life of the running rail increased 25 per cent.

The wear of Bessimer steel rails compared with open hearth steel is as 1 is to 2 in favor of the open hearth. Manganese to Bessimer is as 1 is to 9 in favor of Manganese. Manganese to open hearth is as 1 to 4½ in favor of Manganese. The track at stations is similar to other terminals about New York. The rails are laid on tie-plates with a pad of ½ in. cow-hair beneath, secured by screw spikes to wooden blocks, creosoted and embedded in concrete. The wooden blocks are held down in the concrete by two anchor bolts each. The rail head, originally Am. Soc. C. E. section, has been replaced by a form which would give increased area of contact between wheel and rail, and sloping the side of the rail more nearly to conform with the contour of the flange. By doing this the vertical wear of the rail was increased but the horizontal wear was decreased, thereby increasing the life of the rail. Mr. Dixon does not say if inclining the rail as described in our August issue, page 234, had been resorted to, before the new section was designed, but in any case it would appear that the end sought in both cases is the same thing. Rails can be replaced in from one to two minutes and four anti-creepers to a rail are used on 3 per cent. grades. Screw spikes are not used to any extent on the Interborough on account of the changes involved and because of the difficulty imposed when rail renewals had to be made, especially where time is such an important factor.

In discussing the question Mr. E. L. Mills, Asst. Consulting Engineer of the Public Service Commission, 1st District, said that in writing rail specifications for the Dual Contract lines, viz.: the B. R. T. and the N. Y. Municipal Railway Corporation, they limited the manufacturers to .73 to .86 carbon as against the Interborough .75 to .90. The drop test was reduced from 18 to 15 ft., requiring 4 per cent. elongation for 1 in.; 3 per cent for two consecutive inches, and a permanent set of 1.2 ins. In other respects they conformed to the American Railway Association's specification.

The question of screw spikes was examined by the commission. Many ties in the old subway were found to be "spike killed." The objection to screw spikes is the length of time involved in withdrawing them when rail renewal has to be done. In the design used in the Dual Contract lines, the head of the screw spike is so arranged as to permit the rail to be removed after half a turn of the screw spikehead. Another objection was that in time the screw spike destroyed the thread in the wood and worked loose. A screw spike plate was designed to eliminate this. The plate is a ½-in. tie plate having a boss supporting the spike 1/16 in. clear of the base of the rail. These plates and spikes are under observation, and appear to be giving satisfaction. An experimental section has been installed in the Steinway Tube, called also the Queensborough tunnel. About 2 miles is laid and it has screw spikes and the supporting tie-plates.

Mr. J. V. Davis, Consulting Engineer of the Hudson & Manhattan Railway, spoke of the screw spikes resting on tie-plates. This road uses 85-lb. rails. Cast Manganese rails from England were first used on outer rails of sharp curves, some of them 90 and 150 ft. radius, but now on the outer rails of curves 200 to 500 ft. radius rolled manganese rails are in service and Manganese rolled are in both rails below 200 ft. radius. The 33-ft. length of rail was found to be more satisfactory than longer rails for this road.

ONE THING NEEDFUL

Under the general head of "Causes of Optimism," the *Bache Review* says:

"The optimism to which we have referred may be produced by the wonderful commercial and financial position into which we have, suddenly it might almost be said, drifted or been forced. This position consists of almost unlimited supply of gold, banking money and credit, vast material resources, mostly in great demand from all the world, a crop in the making which bids fair in all branches to be up to high figures. These are things to make us all bulls on the country. Only one, and just one, thing is needed to give us tangible normal internal prosperity. And this is relief for the railroads. The disappointing poverty-stricken condition here, unnatural and unnecessary, artificially produced by rate strangulation, is the great burden around the neck of the nation's whole commercial structure."

GOLD MEDAL AWARDED FOR BUILDING.

The Salt Lake Route-Union Pacific building at the Panama-California Exposition at San Diego, Cal., has been awarded a gold medal for the unique features of the building and the attractive displays therein contained. The structure is known by the name quoted above, and was erected for the purpose of serving as an international transportation center and to provide information to world travelers and comfort to Exposition visitors. The building contains a rest-room for ladies and children, with a maid in attendance. Information bureau and telephone booths, smoking-room for gentlemen, and other accommodations have been provided. At either end of the main reception-room large painted maps of the Salt Lake Route and the Yellowstone National Park are shown on the walls, giving the exact topography of the country.

The entire front of the building shows glass transparencies representing the natural resources of the country traversed by the Salt Lake Route and Union Pacific System. This is said to be the first building of its kind ever erected at any exposition for a publicity exhibit.

Arranging Seasonal Track Work

By W. H. Kofmehl, Roadmaster Chicago, Milwaukee & St. Paul

SPRING TRACK WORK—The first thing should be to get your track bolts and anti-rail creepers in first class condition. This work can be done between times, while the frost is going out or even earlier. Switches should be gone over and every odd job done before the heavy work begins. New ties should be distributed at right angles to track where it can be done, and parallel on fills. By the 25th of March every tie should be in place to put in.

All cross ties, switch ties, head blocks, etc., should be received during the winter months and distributed where needed for the coming season. This work can just as well be done in the winter months as in the summer, and will greatly facilitate the work when the time comes for renewing of ties, etc. Nothing retards the season's work so much in the summer, and inconveniences the roadmaster more, than to be receiving a few cars of ties now and then, to be distributed here and there, over the division, where most needed.

A good plan, which I have followed to some extent when we get the ties in the winter, is to adze the rail slots on all ties that need it while they are being distributed. Any section foreman can make a wooden plane for this work, something on the order of a tie-plate gauge, and while getting the ties to place have one man do all necessary adzing. Every foreman knows what time this saves when renewing ties, especially when you have four or five or more gangs, putting in ties, running for the adze before the tie can be tamped up.

The first thing in the spring, while the frost is going out, is to watch the track daily for bad spots, and keep them in line and level. Take out the high shims, fix up cattle guards and fences, and as soon as conditions will permit commence putting in ties, even if you are able to put in only part of a day at it, on account of other important work. I find the foreman or roadmaster who urges tie renewals early in the season is the one who, as a rule, is up with his work; on the other hand, the man who lags behind on this is usually behind, always.

There are many ways to renew ties, and as most roadmasters have a system of their own I will not go into details; but, for the benefit of some who might not have tried it, I favor the deadening of a few ties each side of the new ones going in, and putting in the ties stiffly enough so that after the first train or two passes over them they are solid. In this way you will disturb the old bed only slightly, and you will get a better job on the new ties than you can otherwise. Where new gravel or steel is to be laid during the season, tie renewals at such places should be left until the new work is going to be done, to save disturbing the roadbed more than once.

Every thorough roadmaster or section foreman must figure to do his work well, and must arrange not to go over the same work but once a season. By this I mean that you will not have to go back some time during the season to pick up a few joints, low spots, etc; but my idea is to do your work so thoroughly the first time that going back over the same ground will be reduced to a minimum.

In the north, after the ground has settled from the frost, there will be many shims left in the track. Such shims should be removed and the ties tamped up, and all really bad places should be taken out. This work should be done between tie renewals, when the weather will permit. My plan is, between April 1 and June 30, to get in ties—every one of them if possible. In the meantime keep the general riding condition of track fairly good, but not losing sight of the fact that the roadmaster or section foreman who can force in his ties by July 1 will be winner of the first prize in the fall when the season closes. I have found this to be a fact by many years of experience. Unfortunately, in the past few years the help has not been sufficient to accomplish the results desired; but the plan of getting in ties early hold goods, no matter where or under what conditions.

SUMMER TRACK WORK.—I have, in a way, outlined the spring work up to about July 1. By this time summer work will begin. On most roads the weeds must be taken care of by this time. On main trunk lines, a good, clean, straight grass line looks well; but it has always been a question in my mind as to whether the money spent each year for this kind of work should not be spent to better advantage to improve the track or improve the station grounds, if we must spend it for appearance. Station grounds should be kept clean all of the time. One day a week should be devoted to this if necessary.

After the weeding is done, according to the desired practice, every section foreman should start at either end of his section, take up all low spots, and put track to level and in good line. In many places he may find a rail-length of track and more which will need raising out of face, but as a rule section forces should confine themselves to getting their track in good line and level. Very heavy work should be done by extra gangs, unless extra section help be allowed for the increased heavy work. By starting at either end of the section, the foreman will go over all his track daily, and should he find a few places getting bad he can take a day now and then and get such places in shape, bearing in mind that the main object is to work out of face, surfacing as much as possible, until the entire section is gone over. Loose bolts should be tightened and high spikes driven down on every piece of track surfaced, and this should be done daily. Any bad spots out of gauge should be regauged. A few new ties should be available along the section, as you anti-rail creepers again if any loose, repairing fences—in the season. This plan of surfacing should be followed day after day, except where necessary to do other important jobs. The weeding along about August will need attention again; but this depends upon conditions and the desires of the officials, and no plan can be outlined here that can be followed throughout.

FALL TRACK WORK.—If sufficient force is allowed for this arrangement, all heavy track work should cease by the middle of October. In nothern countries the force could then be materially reduced, and the balance of October and November should be used for picking up low joints, cleaning out ditches, going over the bolts and anti-rail creepers again if any loose ,repairing fences—and there will be many other things to do to be ready for winter. On most roads we are down to winter basis by the latter part of November, and in most cases only enough men are allowed to do the really necessary work.

WINTER TRACK WORK.—To outline a plan for winter would depend upon what force is allowed. However, winter track work consists prinicpally of shimming, gauging, taking care of snow, etc.—in the north.

The most important of all winter work is gauging. We all know that, with the limited help allowed, practically no gauging is done for years, except where new steel rail is laid. Consequently, our track gets bodly out of gauge. This is a bad condition, and cannot be overcome unless railroad companies will spend a little money to keep the track to gauge. This work can be done just as well in the winter as in the summer, and if it were done and kejt up, as it should be, we would have a much better riding track and save considerable on rail wear, rolling stock, etc. It is important, therefore, during the winter months, to keep this in mind, and every opportunity you get, no matter how small your help is or how little you can do toward it, do what you can, and you will be surprised to find when spring shows up that you will have a couple of miles or so of track that is to perfect gauge. Many advocate, "gauge all track you surface." True, this should be done; but with the limited amount of help allowed it is next to impossible to stop to do much gauging except the very worst places. The Western roads, as a dule, have just about halg the help they should have in the summer, and no help in the winter except for actual necessity. Therefore, the really necessary work must be done first, and that which ought to be done to have everything first-class goes undone.

Most roadmasters agree that we should have a more uniform force throughout the whole year, doing all the work that can be done during the winter months that is now being done during the summer season. By working a more uniform force throughout the year we would have a much better class of laborers, who would remain with us for years and become so interested that they would be very valuable to a railway company. Steady employment at reasonable wages would do more to uplift the track department from its present condition than anything else. Some railroad companies have tried it, and have found that the balance sheet at the end of a year shows some saving, while the supervision and efficiency have been increased beyond comparison over the old way of trying to accomplish a season's work in a few months by working an inferior class of men. My idea is to make every man produce a dollars' worth of results for each dollar he receives. I know of many laborers working for $1.50 per day who do not produce 50 cents' worth of work. This is a bad condition, which does exist on many roads, and a remedy should be applied.

MANAGING SECTION WORK

By Warren Peachey, Supervisor of Track. C. & E. I.

Spring Work—As soon as the frost is out of the ground, which is about March 1st, I scatter out my ties where needed for renewal work. I usually put in ties in March, April and May and have all renewals made not later than June. Six men are placed on the section and start putting in the ties by going over the section and spotting them out.

After getting the ties in we start surfacing and putting in new gravel. The men should be divided up, two working together digging out the old ties and pulling the spikes and four men back of these pulling out the old ties and putting in the new ones, tamping them up and spiking them. We try to get in twelve ties per man per day. The foreman keep up odds and ends such as knipping up new ties for tamping, sighting up the low joints, etc.

I usually lay my new rail in May and June when we can get the delivery of new rails. We have very good success with a gang of 36 men, organized as follows: one foreman, one assistant foreman, one time keeper, one water boy, two flagmen and 30 laborers. Six men are assigned to clawbars pulling spikes, 8 men adzing ahead of the new rail, 5 men shoving out the old rail and putting the new rail in place.

We go ahead with 16 men, eight pairs of tongs and set the new rail up at the end of the ties while waiting on trains so that 4 men can roll the rail in with bars. One man with tie plugs is ahead of the adzers putting plugs in the old spike holes. The adzers drive them down and edge tie off.

Six men do the bolting up and four men spike the track safe to let the train through. Between trains we full spike and bolt the track in good shape. I lay the east rail first from the outside, and the inside rail (the west rail), is laid last. With this organization we have layed 4,000 ft. of rail per day when the longest time between trains is only one hour.

Summer Work—July 1st, I commence to clean the grass out of the ballast, using a home-made sod line cutter by taking a disc 15 to 18 in. in diameter with a rod 1½-in. thick, putting the disc on the outer end and fastening one end to the hand car. This cuts a line 6 ft. from the rail. With a hand-car four men are required to push the car along, but with motor cars the engine will furnish enough power. A motor car will pull the cutter at the rate of about 5 miles per hour. We follow up the cutter with shovels and scuffle hoes and clean the grass out of the ballast. This work is usually completed by July 15th.

We then start cutting the right of way and in places where we can obtain them we use teams and mower. We follow the machines with scythes and cut what cannot be cut with the machine. It usually takes from two weeks to 15 days to complete this work and just as soon as the weeds and grass are dry enough, we burn them up.

Fall Work—In the fall we commence on each section and spot up the low places and joints and usually complete this work by September 15th. We then commence cleaning out our ditches and widening narrow banks. In September and October I have every section foreman go over and tighten up the track bolts. Fall work is usually completed by November 1st and we then cut the men down to a winter basis which is usually 3 men to the section besides the foreman.

Winter Work—Winter work includes spotting the ties which are to be taken out the coming year. This we do by having each foreman go over his section with a pot of paint, spotting the ties to come out and marking the numbers on the telegraph poles. I keep a record of the number to be replaced per mile at the office so that we can tell when the foremen are over-running their allowance. In the winter time we also go over mine and other side tracks and by the time we have this done the ground is frozen so that about all there is to do is to patrol the track and fight snow at switches and interlocking plants. About the first of March we aim to commence on our spring work. In this locality we can commence our work about one month ahead of the Chicago district.

Sublimity is found wherever anything elevates the mind; that is, wherever it contemplates anything above itself, and perceives it to be so.—*Modern Painters.*

To study one good master till you understand him will teach you more than a superficial acquaintance with a thousand; power of criticism does not consist in knowing the names or the manner of many painters, but in discerning the excellence of a few.—*Cambridge School of Art.*

Systematic Reporting of Rail Failures

By Paul M. La Bach, Assistant Engineer, Rock Island Lines

In statistical matters the great desideratum is uniformity. Not only should data blanks be filled out correctly but in a like manner. While it may be possible for the person receiving data blanks to figure out just what was intended, yet it is not necessary that he should be delayed by considerations of that sort. In order to appreciate this, one has but to compile statistics from blanks, each one of which is somewhat different from the others, yet all of which are approximately correct. In making up blanks, it is difficult to frame the questions so that the answer will be apparent, as terms are used in different ways by different people. The reports that must be made out showing the data required for statistics on the subject of rail failures are no exception to the rule. In answering the first question, usually no difficulty is found, but the next five seem to give more trouble, although the markings which indicate the answer are found on the rail itself. Taking the questions in their order, I will undertake to tell what I would consider the proper manner of answering each question.

Question 2. The rail section is in raised characters on the brand side of the rail. The company which rolls the steel has numbers for the different rail sections. Sometimes the section varies slightly from some standard like the Am. Soc. C. E. The steel book of the manufacturer will show this. The marking itself should be given and not some such statement as ASCE., ARA-A., etc. These markings are such as 8504, 9020, etc. It sometimes happens that the rail is pretty badly rusted and this number will aid in identifying the manufacturer, particularly where there are mixed lots.

Question 3. The brand on the rail refers to the name of the manufacturer and the date of rolling. Where the manufacturer has more than one mill, this will be shown also. The Illinois Steel Co. has one mill in which the Bessemer rail is rolled, the South Works, and another in which O. H. rail is produced. The latter is at Gary. The name of the mill tells directly what kind of steel is in the track, but sometimes tells someone else that the steel is of a certain kind and that is put down when the markings are the best evidence.

Question 4. There are a number of kinds of steel in the market, the oldest being Bessemer. When open hearth steel began to be used, the letters O. H. were usually placed to the left of the section number which is next to the name of the manufacturer; thus: O. H. 8504 Illinois Gary 1111 1914. There are different ways of indicating the same thing. Numbers of special steels have been introduced. Ferro Titanium is used in both the Bessemer and open hearth process. It is marked F. T. O. H. in case it has been used with O. H. steel. When without the O. H. it has been added to Bessemer. When there are no markings where the O. H. is usually found, the steel is Bessemer, as a rule. This is not an invariable rule, as I know of a lot of Electric rail that is marked with an X to the right of the heat number.

Question 5. At the mills a number is given to the contents of a furnace or converter for the purpose of identifying it. This is usually called the heat number, although some prefer the term melt. All the records of analyses made by the metallurgists at the mills, physical tests made by the consumers, inspectors, etc., are kept under this number. As the number is constantly changing it cannot be put on the rolls, but is stamped with a die. This number is found, as a rule, on the side of the rail opposite the brand. Care should be taken in getting these numbers as they refer to records and must be compared with them.

Question 6. The rail letter has been added to the heat number for purposes of further investigation in case of failure. It was found that the quality of the rail depended partly upon its position in the ingot from which it was rolled. There are from 4 to 8 rails, depending on weight, rolled from each ingot. The rail made from the top of the ingot is marked "A," the second "B," etc. The last letter is generally "F" or "G." Sometimes blanks show the letter "Q," which is an impossibility. The rail letter is generally stamped to the right of the heat number. The use of rail letters became general about 1908.

It is sometimes of considerable assistance for the investigator to know what is the custom of the mill rolling the steel. The methods of marking the rails have changed from time to time, but the following digest will be found useful as it embodies the latest practice and certain references to former custom. The principal steel companies are given in alphabetical order.

Bethlehem Steel Co. Heat number consists of five figures which are stamped on the side opposite the brand. In order to indicate which furnace furnished the metal, previous to January 1, 1914, the heat number was preceded by a letter; thus: A 17617 D. A indicates the furnace; D shows that it was the fourth rail from the top of the ingot. The letter in front of the heat number has been omitted since 1914.

Cambria Steel Co. The name "Cambria," section, weight, year and month appear at intervals of 7 ft. 4 in. on each rail. The raised letters are ⅞ of an inch high on rail weighing 100 lbs. and upwards, while only ⅝ in. high on lower weights. O. H. heat numbers contain five figures always. Bessemer heat numbers may be from one to five. Before the year 1908 the brand and heat numbers were on the same side of the rail.

Carnegie Steel Co. (Edgar Thomson Works.) Before January 1, 1913 the Bessemer heats were started with number one for each quarter and numbered consecutively until the beginning of the next quarter, so that it was possible to have four heats with the same number each year. The heat would then have to be identified by the month rolled. The heat numbers were hand stamped and consisted of from one to five figures. They appeared three times in a rail length. O. H. steel was marked with five figures, and O. H. stamped to their right, on the side of the rail opposite the brand. The same intervals were used.

Beginning with January 1, 1913, the markings are as follows:

Bessemer heats are stamped consecutively throughout the year instead of quarterly. The heat number consisting of five figures is found three times on a rail length. The rail letter is machine stamped to the right of it.

O. H. furnaces are numbered from 1 to 14, inclusive. The heat number is of four or five figures. The first or first two to the left indicate the furnace, the last one, or two or three the heat number. O. H. is stamped immediately to the right of the heat number.

JJHCo. 2-15-5M

FORM M W. 43.

A. B. C. RAILROAD

REPORT OF RAIL FAILURES IN MAIN TRACKS.

Alaska Division. Section No. 10 Date of Report Oct. 5 1914

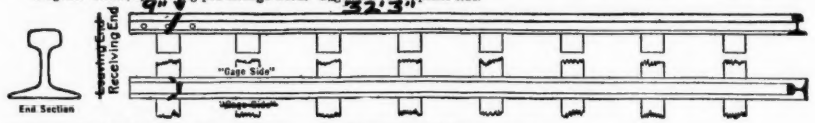
Division No. 50 General Manager's No. 560 Chief Engineer's No. 5640

1. Weight per yard, New 100 Lbs.
   Re-rolled — Lbs.
2. Rail Section? 10020
3. Brand on Rail? ("C" on back) Illinois Steel 1914
4. Kind of Steel? ("D" on back) O.H.
5. Heat No. on Rail? ("E" on back) 12345
6. Rail No. or Letter? ("E" on back) C.
7. Original Length of Rail? 33 ft.
8. Month and Year Rail was Laid? May 1914
9. Location 250 feet West of mile post 117
10. Which Track? West Bound
    Which Rail? Left
11. On Curve or Straight Line? Straight
11½. No. of Curve? —
12. Degree of Curve? —
13. High or Low Rail, if on Curve? —
14. Superelevation of Curve at Break? —
15. Was Rail "Broken"? Yes
    or "Defective"? —
    or "Damaged"? —

☞ (See "Description of Failures" on Back)

16. Was Rail Much or Little Worn? Little
17. By Whom Discovered? Section Foreman Jones
18. Date and Time Found? 6 A.M. 10-5-14
19. Was Rail Removed? Yes
    Date Removed? Same day
20. Exact Gage of Track at "Break"? 4'-8½"
21. Was "Break" over or between Ties? Between
22. Was "Break" square or angular? Angular
23. Distance between edges of Ties at "Break"? 12"
24. Condition of Ties each side of "Break"? Good
25. Kind of Ties? Oak
26. Were Tie Plates used? Yes
    Kind? Std 100#
27. Condition of Line and Surface? Good
28. Kind of Ballast? Gravel
29. Was Track properly ballasted? Yes
30. Kind of Material in roadbed under Ballast? Clay
31. Was Track well drained? Fairly
32. Was Roadbed frozen? No

33. Condition of Weather? (Wet, dry, warm or cold, freezing or thawing) Dry and Warm
34. If "Broken" state cause of break, and describe any flaws found at point of break? None apparent - no flaws or defects found
35. If "Break" was at joint, state kind, number of holes, and whether it was full-bolted or insulated? 4 hole - Full Bolted - Non-insulated - continuous joint
36. Were any bolts at joint loose? No If so, how many? —
37. Was accident or detention to trains caused by "Break"? None
    If so, state circumstances —
38. If "Defective", describe kind and location of flaws or defects, and if possible, what caused them. (See "Description of Failures" on back).
39. Draw on diagram below lines of "Break", or partial fracture, such as long pieces from side of head and half-moon pieces from base, showing dimensions. Hollows in head should be shown on "End Section". Defects may also be indicated on Diagram. Mark distance from end to "Break". *If "Break" is nearest "Receiving End", draw pen through words "Leaving End"; if nearest "Leaving End", draw pen through words "Receiving End". (*Refers to track upon which the current of traffic is in one direction). Indicate "Gage Side" on "Diagram" below, by drawing pen through words "Gage Side" on opposite side.



40. If "Damaged", describe nature and cause if known. (See "Description of Failures" on back)

APPROVED A. B. Cdefgh SUPERINTENDENT

CORRECT R. S. Tuvwxyz ROADMASTER.

☞ Instructions and Description of Failures on back

INSTRUCTIONS.

A. The Roadmaster must inspect all rails broken or failed, fill in this report from personal observation and forward it promptly to the Superintendent.
B. The Superintendent will have copies of this report made immediately upon its receipt and send a copy to each of the following: Chief Engineer and General Manager.
C. The answer to 3 is in raised characters on the web of the rail.
D. The answer to 4 is "Bessemer" (B); "Electric" (E); "Ferro titanium" (F. T.); "Open Hearth" (O. H.).
E. The answers to 5 and 6 are stamped into the metal on opposite side of web showing the brand, figures being used for 5 and a letter for 6.

DESCRIPTIONS OF RAIL FAILURES.

When describing Failures of Rails, the following terms should be used

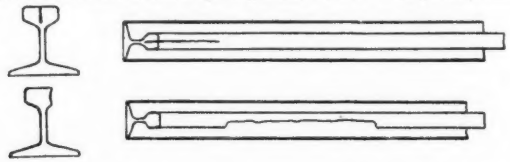
DEFECTIVE

1. **BROKEN RAIL.** This term is to be confined to a rail which is broken through, separating it into two or more parts. A crack which might result in a complete break will come under this head.

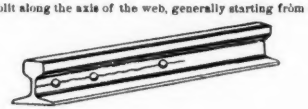
2. **FLOW OF METAL.** This term means a "Rolling Out" of the metal on top of the head towards its sides without there being any indication of a breaking down of the head structure, that is, the under side of the head is not distorted.

3. **CRUSHED HEAD.** This term is used to indicate a "Flattening" of the head, and is usually accompanied by a crushing down of the head as shown in sketch.

4. **SPLIT HEAD.** This term includes rails split through or near the center line of the head, or rails with pieces split off the side of the head. When this term is used it should be further defined by stating whether it is or is not accompanied by a seam or bolt hole head.



5. **SPLIT WEB.** This term is a longitudinal split along the axis of the web, generally starting from the end of rail through the bolt holes



6. **BROKEN BASE.** This term covers all breaks in base of rail and should be described and illustrated on sketches on front page.

7. **DAMAGED.** Under this head will be included all rails broken or injured by wrecks, broken wheels or similar causes.

Standard Form of the American Railway Engineering Association for Reporting Rail Failures.

Colorado Fuel and Iron Co. Formerly the heat number consisting of from one to four figures was stamped on the brand side of the rail. The ingot letter was stamped once near the end. The brand and heat number was apt to become confused so that the practice has been changed. At present the brand, O. H., section number and date rolled appear in raised characters about an inch high. The heat number consisting of four figures is stamped in characters about one-half inch high on the unbranded side of the rail. The brand and heat numbers are found four times on a rail length but the rail or ingot letter is used but once and placed near the end of the rail.

Illinois Steel Co. The mode of marking was changed somewhat in 1914. At the Gary mill the markings are now as follows: O. H. 9020 Illinois G. 1111 1915. The Illinois G replaced Illinois Steel Co., Gary Works, found formerly on this rail. With Bessemer steel the "G" will be replaced by an "S" indicating that it was rolled at the South Works when they have the Bessemer process only. The O. H. will be left off in that case. Heat numbers consist of five numbers for the O. H. rail and from one to five for the Bessemer. They are stamped on the opposite side from the brand and are followed (to the right) by the rail or ingot letter. Also the relative distance the letter stands from the last figure of the heat number indicates which one it is; thus 1 2 3 4 5 A or 1 2 3 4 5 - - - D.

Lackawanna Steel Co. The heat number and rail or ingot letter are stamped on the unbranded side of the rail. The heat number is usually stamped once near the middle of the rail and is near the rail letter. Bessemer is stamped with the heat number only. If it has had Ferrotitanium added, F. T. is stamped near the heat number. O. H. and F. T. O. H. are stamped at the side of the heat number. They begin the year with heat number one for Bessemer steel and follow consecutively throughout the year. Five figures have not been exceeded.

O. H. heat numbers should have four or five numerals. The first or first two is the number of the furnace while the balance indicate the heat from that furnace. The first heat from furnace No. 1 would be 1001. The fortieth would be 1040. From the 12th furnace the 150th heat would be 12150.

Maryland Steel Co. Both kinds or all kinds have the same characters on the brand side; thus: 162 Maryland 1111 1912 90 lbs. The 162 is the section number, the others are the mill, the date April, 1912, and the weight. On the side opposite the brand will be found something like this for Bessemer steel, 2 12345 C. The 2 turned sideways indicates the third ingot of heat 12345. B indicates that the rail was the second from the top of the ingot. The open hearth steel is marked in a somewhat different manner; thus: 2 x 12345 B indicated that 2 x was the number of the open hearth furnace, the balance being the same as the preceding. In the early rollings the x was omitted (first 999 from each furnace). At that time 3456 indicated the 456th heat from furnace 3.

Pennsylvania Steel Co. The company still stamps heat and other such markings on the face of the rail where they are apt to be confused with the brand. The heat numbers of four or five figures are stamped two or three times in a rail length. The rail letter is stamped at least once on the same side of the rail.

Tennessee Coal and Iron Co. The rail letter is stamped in front of the heat number which is placed twice on the unbranded side of the rail. There are five figures in the heat number. On the brand side the only difference from the Illinois is that the month is shown by an Arabic numeral; thus: 7, 1912, indicates July 1912.

The above companies are the only ones now rolling heavy sections in the United States, but in times past there were over thirty in this line of business. The complete list is difficult to obtain, as some only remained in it for a comparatively short time. Table I gives the names of manufacturers whose product is still found in the track, although some of it is now only in branch lines.

TABLE I.—STEEL COMPANIES ROLLING HEAVY SECTION OF STEEL RAIL, AND YEAR OF FIRST ROLLING OF SAME.

1.	Albany & Renssalaer Iron & Steel Co., Troy, N. Y.	1865
2.	Pennsylvania Steel Co., Steelton, Pa.	1867
3.	Freedom Iron & Steel Works, Freedom Iron Co., Freedom, Pa.	1868
4.	Cleveland Rolling Mill Co. (Newburg Rolling Mill), Cleveland, Ohio	1868
5.	Cambria Iron & Steel Works, Cambria Iron Co., Johnstown, Pa. (now Cambria Steel Co.)	1871
6.	Union Iron & Steel Co., Chicago, Ill.	1871
7.	North Chicago Rolling Mill Co., Chicago, Ill.	1872
8.	Joliet Steel Co., Joliet Works, Joliet, Ill. (no rail since 1899)	1873
9.	Bethlehem Iron Co., Bethlehem, Pa.	1873
10.	Edgar Thompson Steel Works, Carnegie Bros. & Co., Braddock, Pa.	1875
11.	Lackawanna Iron & Coal Co., Scranton, Pa. (See No. 30)	1875
12.	St. Louis Ore & Steel Co., Vulcan Steel Co., St. Louis, Mo.	1876
13.	Colorado Coal & Iron Co., Minnequa Rolling Mills, Pueblo, Colo.	1882
14.	Pittsburgh Bessemer Steel Co. (Carnegie), Duquesne, Pa.	1881
15.	Milwaukee Iron Co., Milwaukee, Wis.	1868
16.	Scranton Steel Co., Scranton, Pa.	1883
17.	Troy Steel & Iron Co., Troy, N. Y.	1886
18.	Worcester Steel & Iron Co., Worcester, Mass.	1884
19.	Maryland Steel Co., Sparrows Point, Md.	....
20.	Homestead Steel Works, Carnegie Steel Co.	1881
21.	Lorain Steel Co., Lorain, Ohio	....
22.	Illinois Steel Co., Chicago, Ill. (Made up of 7, 8, 15, 6.)	1890
23.	Western Steel Works, St. Louis, Mo.	....
24.	Tennessee Coal, Iron & Railway Co., Birmingham, Ala.	....
25.	National Steel Co., Main Office, New York City	....
26.	Pittsburgh Steel Castings Co., Pittsburgh, Pa.	1881
27.	Trenton Iron Co., Cooper & Hewitt, Trenton, N. J.	....
28.	Duquesne Steel Co., Pittsburgh, Pa.	....
29.	Springfield Iron & Steel Co., Springfield, Ill.	....
30.	Algonia Steel Co., Sault Ste. Marie, Canada	....
31.	Dominion Iron & Steel Co., Sydney, N. S., Canada	....
32.	Lackawanna Steel Co., Buffalo, N. Y. (No. 11 moved)	....
33.	Southern Iron Co., Nashville, Tenn.	1891
34.	Alleghany Bessemer Steel Co., Duquesne, Pa.	1889
35.	Colorado Fuel & Iron Co., Pueblo, Colo. (See 13)	....
36.	John Brown & Co., Sheffield Atlas Steel Co., Sheffield, England	....

All the other questions are self-explanatory until No. 9 is reached. The distance should be given so that it is a mile post plus the number of feet. The distances should be measured from the mile post having the lowest number as a rule. Where it is between 455 and 456, give the distance as 455 plus, not 456 minus. The direction should conform to this. The direction is generally west or south.

The answer to Question 10 is generally "single track." This should be sufficiently obvious but is sometimes answered "main track." When tracks are numbered the number should be given. When there are two tracks "east bound," "west bound," etc., are the best answers. Which rail? Left or right is the best answer. The direction is gotten by facing the direction the line is running. Face the direction of the highest numbered mile post. That is, if between Mile Posts 455 and 456, face 456.

Question 11½ refers to the custom of some roads to number each curve from some point such as a division point. The first curve is "one," the second "two," etc.

This is not a universal custom, and this question is geneerally a blank.

Question 14 should be answered whether the rail is broken or not. It is frequently found that 12 and 13 are answered but 14 left blank because the rail had a split head. It may be of importance to know what proportion of the axle load came on the low rail, and this can only be told by the super-elevation and the speed.

Question 15 undertakes to divide all failures into three classes. The term "broken" refers to those cases in which the rail is separated into two parts. Cracks that would cause this are also included. It sometimes happens that defects which later develop into "breaks" are not given as the kind of failure. Split webs frequently develop into angular breaks. When this happens the kind of failure should be given as split web, as the defect was the first cause of failure. Also base breaks may develop into other forms. The old seam is usually rusted so that it can be readily told.

Question 17 should be answered by the title of the man, such as section man, train crew, signal maintainer, etc.

Question 22. Care should be taken not to make this answer misleading. Frequently this question is answered "angular" when that form of break was developed from a web split through the bolt holes.

Question 24. This question should be answered even if the failure is not a technical break. It is important to know the condition of ties when there are broken bases and split webs.

Question 30. The answer to this is earth, sand, gravel, clay, rock, etc.

Question 34. Undertaking to tell what is the cause of the break calls for a good deal of judgment. If track conditions are normal and the break is bright and silky, the best answer is "unknown." Before making this answer the rail should be turned over and an investigation made to see if there is a seam running lengthwise of the base. Sometimes when it cannot be seen, a sledge will bring it out. A recent cause of square breaks has been the transverse fissure. This is also known as the silvery oval spot. This is rather difficult to describe without a photograph, but it is in the head of rail and is smooth instead of rough like the balance of the fractured surface. Also it is generally found in the gage side of the head. These spots may be the size of the little finger nail, or take up one-half of the area of the head. It is also necessary to make a careful investigation of the surface of the rail. When the rails are straightened at the mills the marks of the gauge are frequently left on the rail base. Slight indentation near the point of break should be noted. Track conditions should be observed carefully to see if the rail had a good bearing on each tie on either side of break.

In answering Question 35 care should be taken to list as split webs all angular breaks which had their origin in an old seam in the web. The joint fixture frequently covers up split webs which do not make themselves known until the fracture progresses through the head. The proximate cause of the failure lies in the web in that instance. When the failure is non-progressive and all the fracture is new, it may be listed as an angular break.

Question 38. This question covers the majority of cases of rail failures. If it seems apparent that a trans-

TABLE II.—SECTION NUMBERS FOR STANDARD WEIGHTS OF RAIL.

		Old Section Numbers			New							
		Illinois Gary S. Works	Carnegie	Tenn.	Gary S. Works Tennessee Carnegie	Bethlehem	Cambria	Colorado	Lackawanna	Maryl. & Penn.	Algonia	Dominion
A. R. A.-A	100	10,020	100RA	...	10,020	100F	565	...	10,031	163	120	....
"	90	9,020	90RA	902	9,020	90D	563	902	9,031	170	119	....
"	80	8020	80RA	...	8,020	8B	566	801	8,031	...	...	....
"	70	7,020	70RA	...	7,020	....	567	...	....	...	...	....
"	60	6,020	60RA	...	6,020	....	568	...	....	...	...	....
A. R. A.-B	100	10,030	100RB	...	10,030	100G	564	1,002	10,032	161	...	....
"	90	9,030	90RB	903	9,030	90C	561	...	9,032	162	...	....
"	80	8,030	80RB	...	8,030	80C	569	...	8,032	171	...	....
"	70	7,030	70RB	...	7,030	....	570	...	....	174	...	....
"	60	6,030	60RB	...	6,030	....	571	...	....	...	...	....
A. S. C. E.	100	10,001	100A	...	10,040	100A	536	1,000	1,000	247	109	10,001
"	90	9,002	90A	900	9,040	90A	535	900	900	245	...	....
"	85	8,504	85A	850	8,540	85A	531	851	850	235	...	....
"	80	8,004	80A	800	8,040	80A	530	800	800	251	100	8,001
"	75	7,506	75A	750	8,540	75A	529	753	750	214	...	....
"	70	7,010	70A	700	7,040	70A	532	701	700	237	104	7,001
"	65	6,507	65A	650	6,540	65A	534	653	650	236	...	....
"	60	6,015	60A	600	6,040	60A	533	603	600	244	105	6,001
L. V.	110	....	....	...	....	110B	...	...	....	...	...	....
Pennsylvania	100	10,031	100P.S.	...	10,031	100D	558	...	10,030	96A	...	....
"	85	8,530	85P.S.	...	8,531	85D	559	...	8,530	67A	...	....
Dudley	105	10,522	....	...	10,522	105B	...	...	1,051	175	...	....
"	100	....	....	...	....	100C	...	1,001	1,001	261	...	....
"	85	....	....	854	8,522	85E	...	...	851	220	...	....
"	80	8,008	80K	...	8,022	80D	543	...	801	221	...	....
"	75	....	75K	751	7,522	75D	...	...	....	176	...	....
C. P. R.	85	8,542	....	...	8,524	...	...	...	856	...	113	8,501
"	65	6,508	....	...	6,508	...	...	...	654	...	117	6,501
A. T. & S. F.	90	9,021	90X	904	9,021	...	...	903	9,033	173	...	....
C. & N. W.	100	10,035	....	...	10,035	...	...	...	....	...	...	....
"	72	7,201	72N	...	7,250	...	...	...	....	...	...	....
G. N.	90	9,010	90G	...	9,034	90B	560	905	9,030	160	114	....
D. & R. G.	90	....	....	...	....	...	...	906	....	...	...	....
Harriman C. S.	75	7,513	75B	752	7,523	...	...	754	....	...	...	....
" Rev. C. S.	75	7,524	....	755	7 524	...	...	757	....	...	...	....
" C.S.	90	9,003	90S	901	9,023	...	...	...	....	...	...	....
P. & R.	90	....	100PR	...	10,032	...	...	165	....	...	...	....
N. Y., N. H. & H.	100	10,004	100H	...	10,034	100B	...	...	1,002	100	...	....
McKenzie Main	80	8,010	....	...	8,010	...	...	...	804	...	115	8,003
Mo. Pacific	85	8,507	85D	855	8,550	...	...	850	853	...	...	....

verse crack or seam will result in a square or angular break, the rail should be renewed, and Question 15 answered by "yes." One of the chief difficulties found in answers of this question is the term "flaw." It described nothing as ordinarily used. If there is a lap or seam which shows after the mill scale is removed, this may be called a mill flaw. Most defective rails, however, are removed for other reasons than mill flaws, which are of comparatively rare occurrence. The best term is "interior defect." The rail section when new is practically perfect to all outward observation, but something in its chemical composition or molecular structure causes it to break down or form seams resulting in hollow heads or the loss of a part of the cross-section. The best answer is to show on diagrams just how extensive the seams happen to be. Generally speaking they may be of four varieties: laps, pipes, slag inclusion and those due to segregation. Laps are due to imperfect rolling. Pipes are due to the imperfect welding of cavities in the ingot. Slag inclusions are sometimes found. It is difficult to tell segregation seams from pipe unless the latter is discolored by the gases. Generally speaking, if the seam extends down into the web it is a pipe. Segregation refers to a condition in which the different chemical constituents of steel have separated from each other so that the uniformity is lost. When the steel is of the specified chemical proportions throughout, segregation is zero. When the carbon is low and other hardening elements are lacking, the steel is said to be negatively segregated. When too high, the segregation is positive. When two adjacent areas of the cross-section are of different degrees of hardness due to segregation and a rolling load comes upon them, they compress and expand unequally and finally develop a line of cleavage or seam. This seam is the cause of failure and it is difficult for the trackman to tell its exact origin. For this reason considerable care should be taken in making up the diagrams on the blank.

Question 39 should be read carefully and nothing omitted in marking the diagram. This, when properly filled out gives at a glance the situation in the track. The most common error is the omission of distances.

Question 40 refers to those cases in which the rail has been injured before being placed in the track or damaged by defective equipment or improper handling of same after being placed therein. Flat wheels are sometimes suspected of causing breaks but usually leave no marks. Where there are a number or a series of breaks the distance between each should be measured. Burnt rail due to slipping of drivers is another cause. When defective equipment is suspected the matter should be taken up immediately in order to identify the rolling stock doing the damage.

All of the foregoing refers to No. 1 rail, but it sometimes happens that there are failures of No. 2 rail in slow-speed tracks. No. 2 rail is marked by two prick-punch marks on the web of the rail near the end. The latest specifications call for this mark to be placed on the side with the heat number in such a position that it will not be covered by the joint fixtures. There is no special questions for this item but it should be noted in answer to Question No. 1.

WATERPROOFING CONCRETE SURFACES

By Albert M. Wolf.

Some interesting experiences in the waterproofing of concrete surfaces are given in *Reclamation Record*, April 1915, by Mr. J. L. Lytel, project manager of the Strawberry Valley project, Utah. The storage works and tunnel of the Strawberry Valley project are located in the Wasatch Mountains at an elevation of 7,500 ft. The variation of temperature in this vicinity is very wide and the climate in winter is very severe, temperatures as low as 50 degs. F. below zero being recorded, while the snowfall ranges from 10 ft. to 24 ft. in depth.

The extreme cold, with alternate thawing and freezing of water in the pores of the exposed faces of the structures was found to have a very destructive effect on these concrete structures and the waterproofing of the surfaces was decided upon as a preventitive against their continued disintegration.

It was decided to treat the vertical surfaces with alum and soap solutions and the horizontal surfaces with paraffine. The alum solution was made by dissolving 2 ounces of alum $KAl(SO_4)_2$ in 1 gallon of hot water. The soap solution consisted of ¾ pound of castile soap dissolved in 1 gallon of hot water. The paraffine was boiled to drive off water as the presence of water rendered it hard to apply. Ordinary commercial products were used.

The surface to be treated with paraffine was first thoroughly dried and cleaned of loose concrete, dirt and other foreign material. The heated paraffine was then applied with a paint brush and forced into the pores by the heat of a blow torch on the surface. Only one coat of paraffine was applied as the concrete would not absorb more.

The surface to be treated with soap and alum was cleaned as stated and the alum solution was applied at a temperature of 100 degs. F. with a moderately stiff brush, and was then worked in with a stiff horse brush. While the surface was still moist from this treatment the hot soap solution was applied in the same manner, one treatment of each solution constituting a coat. If other coats were considered necessary, they were applied in like manner after the preceding coat had been allowed to stand 24 hours or more.

Twelve structures were given this treatment, the surface area covered being approximately 28,000 sq. ft. Four thousand square feet were treated with paraffine at the rate of 1 pound for 11¾ sq ft. and the remainder with soap and alum. One gallon of alum solution and one-half gallon of soap solution covered 50 sq. ft. with two coats. Two coats of alum and soap were applied at an average total cost of $0.75 per 100 sq. ft., and the cost varied from $0.41 minimum to $1.28 maximum. The cost of one coat of paraffine varied from $1.70 to $3.78 per 100 sq. ft., and averaged $2.11, this cost including everything except general expense. The work was done by two men receiving $75 and $80 per month while brushes cost $6.06, castile soap $0.12½ per pound, alum, $0.18 per pound, and crude paraffine $4.80 per cwt.

The results obtained by this style of waterproofing are considered very satisfactory. The structures that were repaired and treated have passed through two severe winters and no further disintegration of the concrete has taken place in any part.

LIGHT RAILWAY IN MANCHURIA

The manager of a certain lumber company, says a recent Consular Report has submitted a petition to the Ministry of Agriculture and Commerce requesting permission to start a lumber company in Manchuria. The petitioner informs the ministry that there are large forests in the Sungari and Yalu Valleys which cover an area of thousands of li, but the regions being very hilly a successful enterprise can not be launched without the construction of a light railway to cost $2,000,000. This sum, though large, will be richly repaid by the large profits, which are estimated at $8,000,000 annually.

Passenger and Combination Stations, B. R. & P. Ry.

By A. M. Wolf, C. E.

Along with the modern tendencies, which are manifested in different lines of railroad construction, has come the modern railway station of permanent character; pleasing and artistic in appearance. It is not a long step from the time when practically all passenger stations, except in large cities and at terminals, were of cheap, flimsy wood construction built for a strictly utilitarian purpose—a few benches, a "cannonball" stove and the conventional coat of red paint.

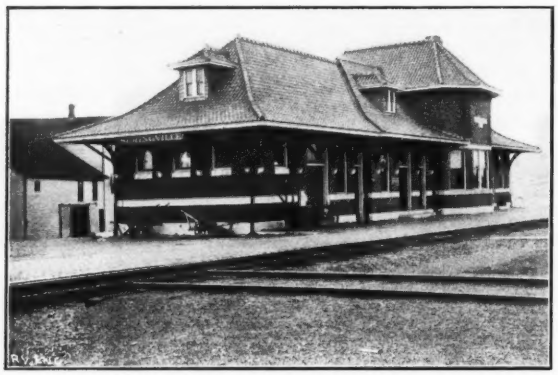


Fig 1—Standard Class A at Springville, N. Y.

The Buffalo, Rochester and Pittsburgh Railway have within the last few years, built many stations of a permanent character, and it is the purpose of this article to describe those stations which are standard types and also some which were made to suit special conditions and needs. The passenger traffic handled at the stations described is generally of a high class and the buildings are designed to meet the demands of such traffic. All these stations have concrete foundation walls carried down 3 or 4 ft. below grade, except in the basement portions where steam or hot water heating plants are used. This portion is in general carried down so as to give a 7-ft. clear basement with 6 ins. of concrete floor. The basement stairs are placed outside the building for standard structures and are of concrete. The exterior walls of all buildings from a point 14 ins. above grade are 13-in. brick walls, with red re-pressed or Craftsman style red bricks called Bradford Ruffs, the former being in general laid in common or Flemish bond with struck joints, while the latter are laid in Flemish bond with raked points. The re-pressed brick are used mostly on the standard stations and the Craftsman style on the special stations.

The window sills and exterior trim are for the most part of cement stone or "Litholite," this material being pre-cast in sections of suitable length, with a finish to match very closely, or harmonize, with the concrete base course above grade. This material is set in the concrete as stone trim and at a much less cost, and for this reason has replaced natural stone, which was previously used for such work. Cement stone trim can be obtained

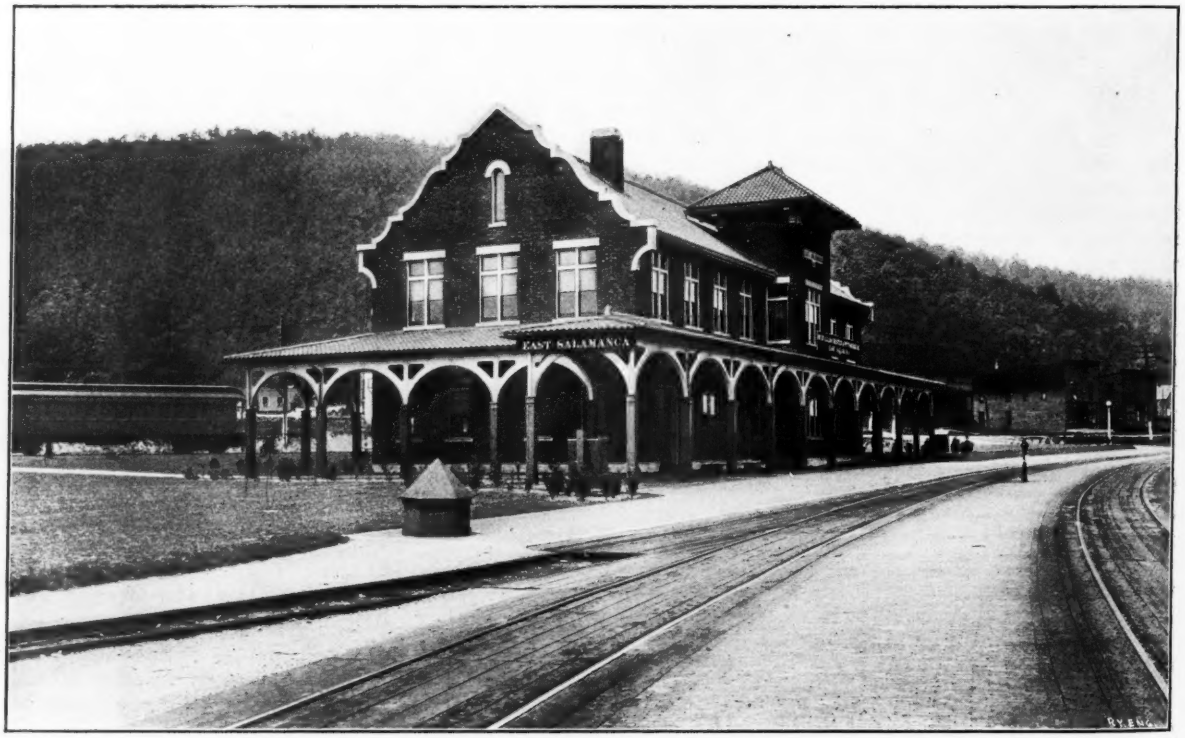


Fig. 6—Through Station, B. R. & P. Ry., at East Salamanca, N. Y.

Times have changed, and the railroads now realize that the comfort afforded by a better class of stations do not by any means decrease traffic, but actually tend to encourage travel over the road which gives the best accommodations.

nowadays in almost any desired surface and finish, and it promises to replace cut stone and terra cotta to a large extent in localities where it can readily be obtained.

In large stations the main or bearing wall partitions are 13-in. brick walls, while the toilet and office partitions

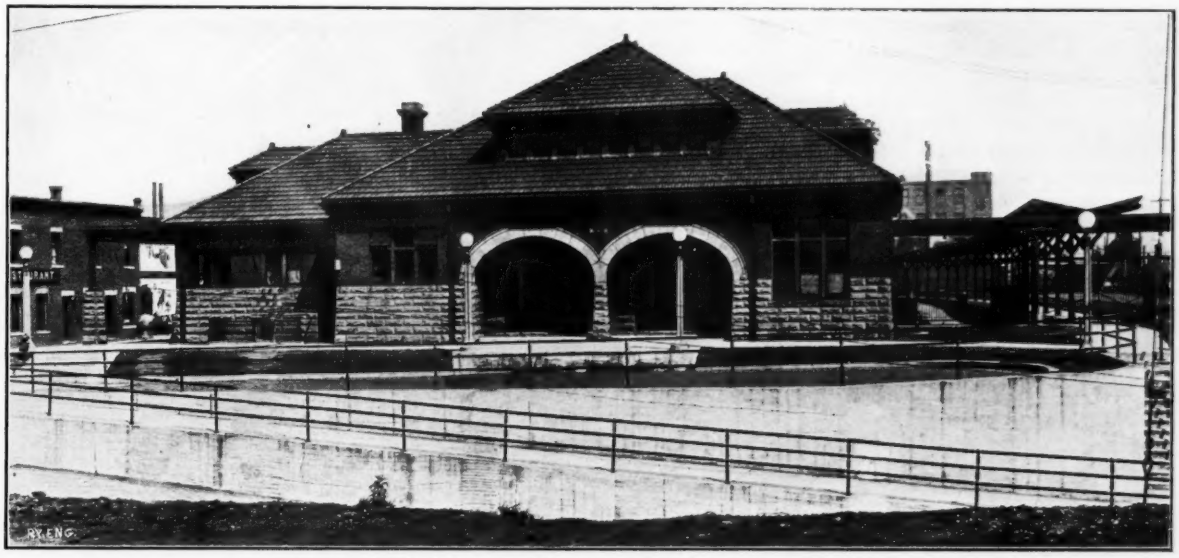


Fig. 5—Terminal Station on the B. R. & P. Ry., at Salamanca, N. Y.

are of wood studs lathed and plastered. In the smaller stations all interior partitions are of wood.

The general type of roof construction is of trussed rafters of wood, spaced 16 ins. centers, with sizes and method of trussing varying for the different span lengths. The rafters are covered with 1-in. hemlock tongued-and-grooved sheathing, upon which is laid a Ludowici-Celadon red clay tile of either the French or Imperial Spanish tile. The roofs are in general given a 1-3 to 1-4 pitch.

Platform canopies are not used for standard stations, and the roofs are given an overhang of 6 ft. from the building line to provide shelter, the eaves being ceiled with V-grooved yellow pine ceiling. Copper-lined gutters carry the roof drainage to 4-in. wrought-iron pipe conductors, discharging into a 4-in. cast-iron pipe brought up about 4 ft. above grade and connected with sewers. The exposed portions of the chimneys are of the same kind of brick as the building walls, with a standard concrete cap at the top.

The floors of the main portions of the stations consist of a ⅞-in. tongued-and-grooved hemlock laid diagonally on the joists. Upon this is placed a layer of building paper, and then a ⅞-in. tongued-and-grooved comb-grained yellow pine flooring, laid to form the wearing surface. These floors are left the natural color and oiled. Ten inch sanitary cove base is in general use in conjunction with this type of floor, wood base being used only in a few cases. The toilet room floors are of tile with a wainscot 6 ft. high of the same material. The walls and ceilings of the office and waiting rooms are plastered and have an oak wainscoting extending to a height of 5 ft. above the floor line. A crown moulding is placed at the ceiling and in some cases picture moulding is placed 9 ft. 4 ins. above the floor. The ceiling height is in general 13 ft. except on the smaller stations where a height of 12 ft. is used.

The train order rooms have a 6 ft. wainscot of No. 16 gauge ingot iron with plastered walls and ceiling. The ticket offices have wood partitions glazed with Florentine glass from wainscot to ceiling. In the freight and baggage rooms the brick walls are left unplastered and the ceilings are of yellow pine laid diagonally. In some cases the inside walls of baggage rooms are covered with face brick. The baggage and freight room floors are placed on a level with the platforms while the main floor of the building is raised about 1 ft. 2 ins. above this level, concrete steps being provided at the exterior doorways.

The doors used are of the three-panel type shown in our illustrations with glass in the top panel. In exterior doors plain glass is used while Florentine glass is used in interior doors. Transoms are provided over all exterior doors. Double hung windows 7 ft. 6 ins. high and about 3 ft. wide, are used except in toilet and baggage rooms where windows half the size of the double hinge type are hinged at the sides or bottom. The operator's desk is placed in a bay or octagon provided with three to five windows so as to give a clear view of track.

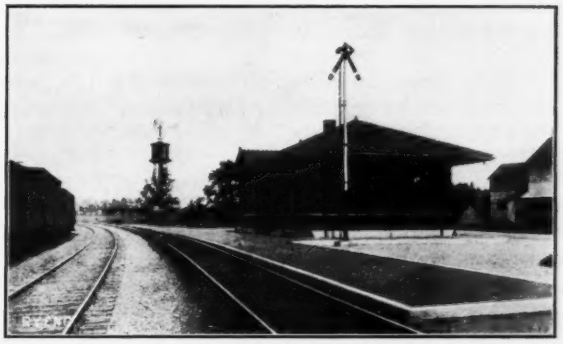


Fig. 2—Standard Class B, Scottsville, N. Y.

Wooden settees of the type shown in the engravings are placed around the walls of the waiting rooms, while in the general and the women's waiting rooms two additional settees are placed back to back in the center of the room, with a radiator housed-in between them.

The platforms around stations are of vitrified brick laid on a cushion of sand placed on a cinder base, retained by concrete curb walls 3 ft. deep. The standard width of the platform on the track side is 18 ft. while on remaining sides an 8 ft. platform is used. Cast iron wheel guards are provided at all corners and at baggage and freight doors.

The accompanying illustration, Fig. 1. is of the standdard class A passenger station 28 ft. wide and 99 ft. 8 ins. long, erected at Springville, N. Y., is typical of stations of this class. It will be noted the structure is treated architecturally so as to emphasize the waiting room and office portion as the main part of the building and treat the baggage room as a wing.

In Fig. 2. is shown a standard Class B station at Scottsville, N. Y. for combined passenger and freight service. The general waiting room, 24 by 26 ft. in plan, is located at one end of the building, and the freight room 26 ft. square is at the other end with the ticket office and toilet rooms between. A small portion of the freight room is partitioned off, to form the train order room. The building covers a ground area of 28 by 67 ft. 8 ins. and has a basement for the heating plant. The greater portion of the traffic at this station is caused by suburban travel to and from Rochester, N. Y.

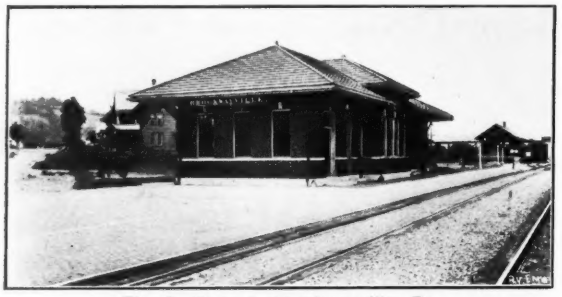


Fig. 3—Class A, Brockwayville, Pa.

Another type of passenger station laid out along the same general lines as the Class A station but of smaller dimensions, is the Brockwayville, Pa., station shown in Fig. 3. The ground area covered exclusive of bays is 76 ft. 8 ins. by 24 ft. The waiting rooms and baggage room are somewhat smaller than those of the Class A station. This station was put in service, in March 1913.

A small combination passenger and freight station as built at Stanley, Pa., is shown in Fig. 4. This station covers an area 26 ft. by 50 ft. and is divided into a general waiting room, baggage and freight room, train order room and ticket office.

The terminal station erected at Salamanca, N. Y. in 1912, is of a different character to the stations just described as shown by Fig. 5. The base and trim are of Cleveland sandstone with red re-pressed brick walls which are laid in Flemish bond.

The general waiting room about 30 ft. by 28 ft. in plan and is between two narrow wings which constitute toilet rooms and women's retiring room at one end. Ticket office, parcel room and baggage checking room are at the other end and baggage and express rooms are in a wing adjoining the ticket office. The basement is placed under this portion of building.

At East Salamanca, N. Y., the traffic is largely through travel, this being a transfer point for trains to and from Rochester and Buffalo; and a comparatively small station has been laid out in what is otherwise an office building. The architectural treatment of this structure is quite different from that of the others as will be seen from Fig. 6. A covered platform extends around the entire structural and brick platforms are provided between the tracks to allow of transfers from train to train. The waiting room, ticket office and toilet rooms occupy the middle portion of the first floor, while the remainder is divided into offices as is the second floor. The construction details of this building are much the same as those of other stations. The plans and specifications for all these buildings were prepared in the office of E. F. Robinson, Chief Engineer of the B. R. & P. Ry., to whom the writer is indebted for the plans, photographs and data used.

NECESSITY FOR CARE OF TRACK TOOLS

By O. A. McCombs. T. & P. Ry.

One of the duties of a section foreman is to look after and take care of his track tools, and to see that they are kept in serviceable condition at all times. This duty should not be relegated to some one else as of minor importance, because it is very important that all tools be kept in good condition. Every tool should have a particular place in the tool house, and when not in use should be kept in its place so that anyone familiar with section tool houses and track tools could go in and readily get any tool.

There should be no hiding of tools in out of the way places, as upon the plates or under the house or in some niche or corner where it cannot be found when wanted. Some laborers hide tools to keep for their own special use or for emergencies. This should not be permitted. I have known men to be put to a great deal of unnecessary inconvenience when called out at night to repair a switch broken by having been run through, by not being able to find a monkey wrench or a log bolt wrench in the tool house. They had to go to the round house, a mile or so away, or get one from a switch engine. There were wrenches in the tool house, but they had been hidden by some of the day men. It was often more trouble at night getting a wrench than it was to do the work in putting on a new lug or a bridle. These tools are frequently hidden so well that one cannot find them until the tool house is cleaned out and an inventory taken or the officials come by on an inspection trip and things are cleaned up. The official have a peculiar way of finding things a foreman thinks he has hidden.

Do not keep tools other than your regular track tools, about your tool house which you will not need, only once in a great while. Do not keep broken and unserviceable tools. Send all such tools to headquarters. It gets them out of your way and puts them where they can be made ready for service. Keep hand cars and push cars in good order. Keep all bolts tight. Hand and push cars receive the greatest amount of damage from rough and careless handling in lifting off and on tracks on account of their weight. These cars are built as light as practicable to carry the load intended, but they will not stand the rough usage that the majority of section tools will stand. Hand cars should not be thrown around and dropped when taken off the tracks. Heavy loads should not be thrown on them and they should be kept well oiled and all the bolts and nuts kept tight. See that the brake on your hand car is kept in good order. I

Fig. 4—Passenger and Freight Station at Stanley, Pa.

account of brakes being in bad order than from any other cause.

I received at one time twelve small hand cars, new from the manufacturers. These cars were allotted to the sections where we expected to have the smallest number of men. Each car was numbered, and a record kept of them, and when they had to be sent to the shop for repairs they were returned to the section to which they were first allotted. These sections had previously had all large hand cars made in the company shops. The majority of these small cars were soon broken and being sent to the shop for repairs; the foremen said they were too light, and too easily broken. They were light, of course, and would not stand the rough treatment some of the foremen thought they ought to stand. One foreman ran his car six years and it had not been sent to the shop for repairs, and it was still in good running order the last time I saw it. He had taken care of his car.

Track chisels, axes, adges, scythe blades and drill bits should be kept sharp. Track gauges should be watched closely to see that they are in proper condition at all times. The gauge commonly made of iron pipe, with a piece riveted on each end, is very apt to get loose in the joints. I have seen a great many of these gauges, loose at both joints, as much as ½ in. short of the standard.

I had an experience with a gauge in bad order of that kind one time which I will not soon forget when I had a piece of track on a curve at the foot of a long grade. There came a slide in the dump and the track had been thrown over around the slide. The track was continually settling.

I kept two watchmen there at night. One morning when I went out I tried the gauge on a wide looking place at the slide and found it to be about 1½ ins. wide. I at once gauged the track in, but I had not gone far when I discovered that the rivet had broken out of one end of the gauge and the pipe had been driven into the end piece until the gauge was about 1 in. short. It was all snug and tight.

I feel a little nervous yet when I think of what might have been the result of gauging the track with a gauge like that. Such a gauge should be taken apart or broken so that no one could use it.

See that your track level is true. Track levels on account of the rough usage they receive often get out of true. Some foremen when they find a level a little off, use it with a certain end always on the same side of track. That would be better than turning it first one way and then the other but it is bad policy to use a level that is not true. It is just as easy to surface track with a level that is right and true as to do it with a bad level.

I once knew an extra gang foreman to put up a long stretch of rock ballast track, first class in every way except that it was 2 ins. low on one side caused by a bad level and the carelessness of the foreman in not seeing that his level was true. When he found his level was off he just told his level man to turn one end north and go ahead. This work could have been done just as easy with a true level and it would have been right and not cost a cent more.

Spike mauls should have good faces and good handles, and the heads should be securely wedged on handles. A spike maul loose on the handle is a dangerous tool to work with in a gang. I have known serious accidents to happen from this cause.

Lanterns, torpedoes and flags should be kept ready for service. A good way to keep lanterns that are not used much, is to keep them cleaned and trimmed and ready for service. Do not fill the lamp with oil. Keep the oil handy, in a can near the lanterns and when the lanterns are wanted they can be filled in a few minutes. Lanterns that stand full of oil for a long time unused, do not burn well.

Keep good shovels, picks, claw bars and good track wrenches. A claw bar that will not pull a large majority of all exposed spikes should be sent to shop. Wrenches should be such sizes as to fit all the nuts on the track.

Dump boxes should be kept on a couple of old ties, and not thrown on the ground to rot. Track drills should be handled by competent men. Men who will be careful to get the best results and not break the drill. Some men have a habit of breaking tools and putting things out of order. I have known men to manipulate a drill so as to break it in order that they would not have to drill with it. Others break tools through ignorance. I have known men to toss a maul away in such a manner that the end of maul struck the hard ground and snapped the handle off. One lesson ought to be enough for a man in this case. I knew one laborer to make a practice of breaking hand car levers just to show the other men how strong he was. When the hand car was running heavy loaded, and was being slowed down to stop, when it got slow enough he would brace himself and take hold of the lever, stop it suddenly and twist it off. He did not care how much he inconvenienced other people if the foreman did not catch him at it and discharge him.

It sometimes occurs at train accidents that trains are delayed several minutes on account of poor tools to work with, a spike maul with a broken handle, a wrench too large for the nuts, a claw bar that will not pull a spike out of a good tie.

Keep your tools in good order; do not be in too much of a rush to get something done that you neglect your tools. You cannot do satisfactory work with tools that are out of order. When any one is injured by a tool, the first claim is on account of a defective tool, whether the defect caused the injury or not. Keep things right, be honest—play the game!

PROTECTION OF SINGLE A. C. TIE LINES

Single-pole, double-throw relays of the type illustrated have recently been developed by the General Electric Company. These relays provide a simple and effective means of automatically isolating trouble on a single tie line joining parts of an alternating current system. Two relays connected together by pilot wires are required on each end of a three-phase tie. Under normal conditions, irrespective of the direction of the power, which may reverse at any time over the entire tie line, depending on the distribution of the load and the characteristics of the system, the relays have no effect on the oil switches.

If, however, a short circuit occurs in the tie line while power is being fed from one part of the system to the other, this power will go directly into the short circuit while the power in the tie between the "short" and the part of the system previously receiving power will reverse and also feed into the "short." This will operate the contacts of the relay in the reversed portion of the line, which will cause the oil switches on both ends of the line to trip and isolate the line from the rest of the system.

The relays will not operate on overload, or on trouble on other lines unless accompanied by a reversal of power only on one end of the line which they are meant to protect. They will, however, operate on very little reverse power, even at low voltage and low power-factor, and are consequently efficient for the service recommended.

Automatic Electric Switch-Point Locking

An interlocking system, developed in Pittsburgh, Pa., has for its main object increased safety and certainty of operation of railroad switches. It is based upon the well-known principle of a facing point lock movement. It is believed by many that in mechanical interlocking the facing point lock is safer than the switch and lock movement. For this reason it is very

Fig. 1—The Tower Machine.

largely used in all mechanical plants. In the Gray System the function of locking and unlocking a switch or derail is performed by an entirely independent unit of the switch machine, from that which performs the actual throwing of the switch or derail. This is accomplished by dividing the switch machine into two units; one consisting of a solenoid and the other consisting of a motor with the necessary reduction gear and clutches. The solenoid performs the function of locking and unlocking. The motor throws the switch points. Each of the units is furnished current through separate controllers in the tower machine.

In the design shown in Fig. 1 the tower machine is a miniature Saxby and Farmer instrument so arranged that either Saxby and Farmer, or Stevens locking can be applied. The levers are placed at 3 in. centers and made very strong. When a separate lever is used to control each of the two units of the switch machine, the controllers are vertical and are in the front of the machine and operated by the lever latch. When a single lever is used to operate both the lock controller and switch controller, then the lock controller is located as in the former case and operated by the lever latch while the switch controller is vertical and is at the back of the machine and operated by the lever. The stroke of the controllers from normal to reverse is 2½ ins. The lift of the latch is ⅜ in. The stroke of the locking 1½ ins. The entire machine is enclosed in a cabinet, thus preventing any tampering with the indication or the locking.

The indication quadrant Fig. 2 is placed on the rear of the locking shaft and normally holds the lever latch from taking its full down position. As soon as the indication has been received and the indication latch lifted, the lever latch spring will complete the movement and thus release the mechanical interlocking, thereby serving as a stroke complete. A second quadrant is placed above the indication quadrant and in this quadrant works the latch of the track detector magnet or track lock. In both cases the latch is forced down into position by the movement of the lever latch, thus assuring that the latch can in no case be stuck up; that is, the latch cannot be stuck into such a position as to permit a false movement of the lever.

The switch machine, as was previously stated, is divided into two units, but both housed in a single box,

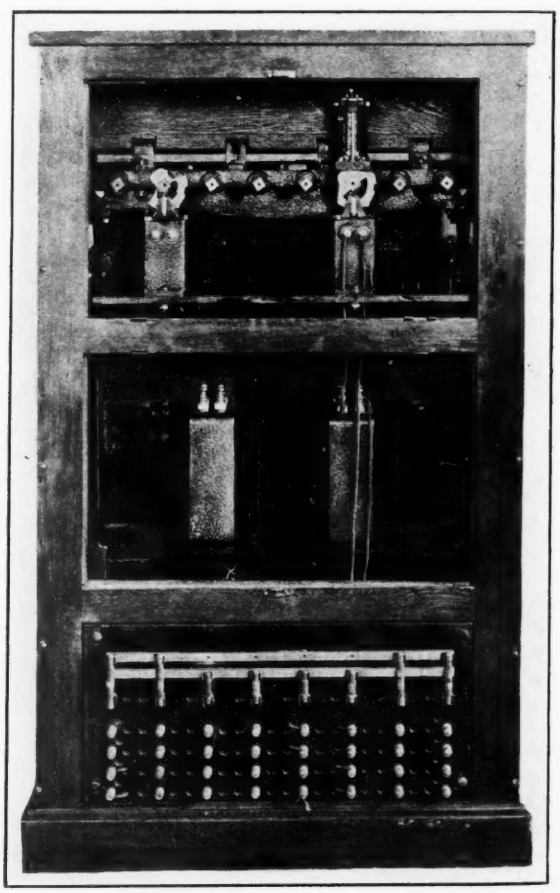


Fig. 2—Indication Quadrant Near Locking Shaft.

Fig. 3, one unit doing the locking and unlocking and which consists of a double solenoid so arranged as to draw a plunger both in or out of a notch on the lock rod and seen to the left in Fig. 4. The second unit or throwing unit is a small motor with a reduction gear driving a crank, which in turn operates the throw rod and seen to the right in Fig. 4. The complete movement of a switch, that is, unlocking, moving or throwing and re-

locking, is thus, by the Gray System, performed in stages just as is done by the present mechanical machine, instead of in one continuous movement. The advantage of this is that safety magnets are provided, one for each unit, whereby the electric current is prevented from affecting any stage of the operation unless the previous stage has been properly completed and the levers in the tower machine have been moved to correspond to that action.

There are two safety magnets or auxiliary locking devices, one associated with the lock unit and the other associated with the throwing unit. Through these safety magnets and through them only, can power be applied to either the lock solenoid or the motor. Also, as long as either of the safety magnets is energized, it holds mechanically locked the other unit of the switch machine. To state it another way: If current is applied to the safety magnet associated with the lock solenoid and thereby applies current to the solenoid, then this safety magnet or auxiliary locking device holds the throwing unit mechanically locked and as long as that current continues to flow, wether it be due to a cross, grounds or otherwise, just so long will the throwing unit and the switch point be locked. Conversely, if the switch is lying locking in either position and current be applied to the next operating wire for the motor, then the safety magnet associated with the motor, is energized and mechanically engages the lock plunger whereby it cannot be withdrawn from the lock rod as long as this motor operating wire remains alive. The effect of this is that if power is supplied to any of the operating wires out of sequence, the current causes the switch to be locked and its movement prevented.

The main feature of this system resides in making the switch machine self protecting, so that, even if power improperly reaches it, such power will lock the switch machine and switch in the position which they then occupy rather than rely upon some form of cross protection at the tower, and which operates only in case of a ground or cross. As it is necessary for these safety magnets to move at each operation of the switch machine, it will be seen that the cross protection must always be in an operative condition.

Another novel arrangement of the switch machine is

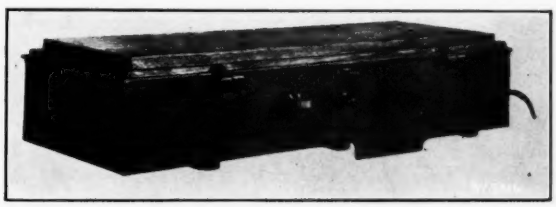


Fig. 3—Both Units Housed in One Box.

that the motor always runs in one direction, thus not requiring any pole changing device. The reversal of the movement being obtained by selecting either a normal or reverse clutch on the planetary reduction gear. The Gray system is adaptable to either A C or D C, high, or low voltage. It can be arranged to take the operating current through the tower machine, or to have the safety magnets at the switch act as relays and cut in a local operating current, thus requiring the tower controller to make and break only a small control current; this latter method being adaptable to large plants or to low voltage distant control. The time required to perform a complete operation is about 2½ secs.

The indication is obtained by generating a current at the switch after the solenoid has drawn the lock plunger into the locked position. This generated current passes through a pole changer operated by the lock rod, and then a pole changer connected to the switch controller in the tower machine and finally operates a polarized relay that cuts in a local circuit, that energizes the indication magnet. This entire circuit is independent of any of the operatng circuits and beng polarized insures that the switch points and lever are in their corresponding position, and also that the lock rod must be in place.

To sum it up, this system differs from others: by performing the movement of a switch in steps instead of by one continuous operation; by dividing the switch machine into two units controlled by safety magnets, instead of having it a single unit; by placing the cross protection at the switch; by having the motor always run only in

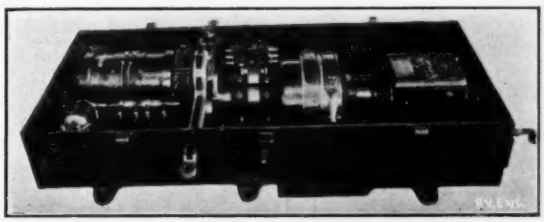


Fig. 4—Switch Machine With Cover Removed.

one direction instead of reversing it by a pole changer; by having an indication current generated at the switch by an entirely independent unit.

UNCLE SETH'S CASE

Seth Raynor—"Uncle Seth," as he was known by the boys on the road—has long since been gathered to his fathers; but he was a remarkable man in his way. He was station agent at Manor, on the Long Island Railroad, for more than forty-four years.

He assumed this position to fill another man's place, which was vacant for a day on account of illness, and remained in it uninterruptedly for forty-four years afterwards.

He mentioned a Sunday "off" once, in 1858, on account of measles; but that was the only vacation which fell to his lot in nearly half a century. Faithful, tidy, prompt and polite he was, too.

If anybody has ever been bold enough to alight from the train at Manor and look over this unknown hamlet, he will readily appreciate how much patience and good nature it requires to fill the station agent's place there for any length of time. "Far from the madding crowd" it is, and so peaceful and quiet that the birds shun it, and the hum of the insects is especially subdued. When the train arrives and quickly puffs away, there is the usual excitement. If one is anxious to know the total population of the place, he can easily count the inhabitants while he waits, for they are all on the platform when the train pulls in.

When "Uncle Seth" resigned his position on account of age, after all these years of pressing duty, he came up to Long Island City for the first time in over forty years, and modestly requested a pass, good for thirty days over all lines of the road; got it, and thereupon for the first time set out on a tour of Long Island. When his trip was finished he called upon the general superintendent, thanked him for his kindness, and cheerfully added: "Now I can die happy; I have seen *all* of Long Island."

On his tombstone it might well have been written: "His life was one of hopeful to-morrows and cheerful yesterdays." Though his life may have all been rounded out within an extremely limited compass, no one more faithful and constant ever lived than "Uncle Seth"

The Maintenance Labor Problem

This subject as presented by us has brought forth much valuable as well as interesting information. The very complete and satisfactory replies which have been submitted indicate the importance of this matter and show with what care the problem is handled. In addition to what has already been published we offer in this issue the summary of methods employed on various other large roads. It can be gathered from these reports that this feature of the maintenance department has been practically standardized so that to-day the general methods employed throughout the country are quite alike.

Atchison, Topeka and Santa Fe, by A. G. Wells, G. M.

The greater number of our track laborers are Mexicans, who come to us from El Paso, Texas.

Our track laborers are furnished by an incorporated boarding commissary company, free of charge to the railroad company, the consideration being that the boarding and commissary company has the privilege of selling goods to the men they send us, deductions being made by us on pay rolls of amounts covering such sales.

We have no employe at private labor agencies to accept shipments of men for the company.

The labor bureau (or company) from which we get our track laborers is incorporated under the laws of California, and is composed of a president and board of directors, who have stores at many division terminals from which they distribute men and goods to the various sections and camps on their respective districts.

Extra gangs are often reduced in the winter, but as a rule the section forces on the Santa Fe Coast Lines are nearly the same the year around.

We furnish one-story house of wood, concrete and tile construction, also fuel and water free, and the men do their own cooking.

Our Mexican track laborers have the same medical attention and hospital treatment as white men in other departments. When they have served six months they may get a special rate ticket to El Paso, Texas (the majority come from that vicinity), and at the end of one year's continuous service they may get a free pass to El Paso.

When they have learned a little English and appear to be capable as track walkers, "straw bosses" or subforemen in extra gangs, they are given such jobs at a regular monthly salary. Later if they prove efficient and dependable, they are often assigned to sections as foremen. Only a few make first-class foremen.

No regular course of study or apprenticeship is followed. We often have to try several of the best Mexican workers before we get one who is any good as a foreman. Many of these men who do good work when working under regular foremen are failures when put in charge of a gang. They have but little executive ability, and are not resourceful.

We have no well defined system for promoting our Mexican laborers. When one works more than two or more years on the track and attracts the attention of his foreman he is frequently allowed to raise, line and surface track, and if he proves to be dependable and capable, is given a place as assistant in an extra gang or yard. A few of these Mexicans make foremen, but the percentage is small.

I do not think that either our foremen or laborers are any more competent or dependable than they were twenty-five years ago. They are, as a rule, more restless than they used to be. We do not promote many of our track foremen from the ranks. On account of our laborers being Mexicans we have very little good material to draw from, and we have to get the majority of our experienced white foremen from the middle west.

I cannot offer any suggestions at this time for an improvement in the standard of our track men. White men, such as we require for section or extra gang foremen, are not working on the track on the Pacific Coast, and I do not think that the railroad companies can afford to pay wages enough to induce young, capable white men to engage in ordinary track work. Occasionally we get the son of a section foreman to work awhile as laborer while he can board at home, but he soon seeks a place in some other department where the compensation and environments are more attractive than those of the track department. I refer particularly to the Pacific Coast and Rocky Mountain territory.

Delaware and Hudson, by C. S. Sims, V.-P. and G. M.

Practically all our laborers are procured from points along our own line, and a few from New York City.

Laborers are hired direct by section foreman. In a few cases we hired an interpreter for use in procuring men for extra gangs and to fill out section gangs. Usually the men in the gangs have relatives or friends for whom they wish to secure employment, and we are thus enabled to bring our forces up to the required quota.

We reduce forces in the winter, but have a certain number of men who are employed the year around. We are usually able to secure in the spring the same laborers, or a large percentage of them, who were relieved in the fall. This is accounted for by the desire of the men to secure permanent places, our section foremen being promoted from the rank and file.

Where accommodations cannot be secured elsewhere, we furnish a box car for the men and allow them to furnish it as they please. A number of cars are supplied for extra gangs and sectionmen and laborers have been comfortably housed in every instance.

Competency alone is considered in promotion of track laborers. The ability to handle men and maintain track properly, secure for the laborer promotion either as assistant foreman in some yard, "straw boss" or track walker, carrying with it a slight increase in pay. In these positions the man is given an opportunity to show his fitness for further promotion.

It is believed that by our method of promotion, and retention so far as possible, in the service, a spirit of loyalty is inculcated in the men, and a feeling of permanency instilled in their minds, and with this feeling extant better results are procured from them. Half-rate tickets are granted the men upon request at any time, for transportation over the line, which practice we feel keeps the men satisfied and engenders the feeling that their services are appreciated.

With the economies which it is necessary to effect in railroad maintenance, do not believe further privileges can be granted the men without incurring a prohibitive expense.

Northern Pacific, By Geo. T. Slade, Gen. Man.

We endeavor to employ as many laborers as possible locally; that is, we try to furnish employment in our track department to young men living along the line of our road. In certain of the better settled sections of our country, our track laborers are largely recruited in this way. The deficiency in local labor is made up by the employment of foreigners, who are recruited in the larger centers along our line and, occasionally, when these sources of supply fail, in Chicago and St. Louis. This labor is hired through the medium of a private labor agent, who employs track and other common labor exclusively for our company. The man in charge of this work has been so engaged by our company for some thirty years. We do not, therefore, have a company labor bureau, our labor agent deriving his income from the employment office fees he collects. In most of our territory it is necessary to reduce our track forces in the winter, although in Western Washington, where the winters are not so severe, we maintain nearly as large a force in the winter as in the summer. We provide comfortable bunk cars for extra gang laborers and bunk houses for section men. The foreigners board themselves and contracts with responsible boarding concerns guarantee first-class board and bedding at specified rates for the native labor. No special inducements are offered trackmen except that they are furnished a reasonable amount of free transportation. Those who wish to remain with us over the winter are permitted to occupy bunk cars or outfit houses and are furnished free fuel by our company.

In our terminal yards we employ assistant foremen, who are promoted to foremen as the requirements of the service demand. We have no form of apprentice or instruction course except that our roadmasters are constantly developing men from among their forces to accept more responsible positions as the service requires. By furnishing men good board, comfortable quarters and permitting those who wish to remain in the outfit cars or bunk houses free of charge during the winter months, we are successful in holding a sufficient and reliable force of track laborers. Through the Northern Pacific Beneficial Association (supported by the employes through small monthly contributions deducted on the pay rolls) hospital, medical and surgical services are provided for our track laborers and this is undoubtedly much appreciated. We have no plans for any change in the method of handling our track laborers.

Pere Marquette, by A. L. Grandy, Chief Engineer

For the regular forces employed to do the usual maintenance work on track, bridges and buildings, we employ native labor, and have been very successful in maintaining our percentage of native labor up to this amount. These men, of course, for the most part, live at home, or if single, fine board and room in American families. They, of course, look after their own comforts and living conditions.

These men are all Italians and are furnished by an Italian Labor Agency in Chicago. We do not employ any one to look up these men or pay any compensation to the agency. The men secured in this manner are satisfactory for this class of labor.

This company maintains an employment bureau at its general offices, who handle all employing above the grade of labor, but do not undertake to handle the supply of common laborers.

These extra men are, of course, employed, during the summer, or working season, and only such work is started that can be completed before winter.

All of our ordinary maintenance forces, about two-thirds of them, are employed the year around. The force is increased during the summer working months and reduced again in the fall.

The Italian laborers live in box cars and look after their own board.

No special inducements are offered to obtain track men in our employ, other than the wages and assurance of steady employment.

The section foremen are always selected from our track laborers, the selection being entirely on ability without particular reference to seniority. We do not make use of any apprentice or instruction system.

This company is making a trial of a piece-work system for track laborers, on which arrangement the men, as well as the foremen, reap the benefit of any extra effort they are willing to put forth, or any way in which they can "work their heads to save their back." The prices paid under this piece-work plan are liberal and we think, when well established, will increase the labor opportunities to secure greater service and through that will attract a better class of men to this kind of work.

Union Pacific System, by Charles Ware, Gen. Man.

As requested we here give you answers to questions asked in regard to method of securing and handling laborers. We get them at Omaha, Neb.; Kansas City, Mo.; Denver, Colo., and Ogden, Utah.

Other than those hired locally by section foremen, our track laborers are secured through private labor agencies.

All laborers hired through outside employment agencies are required to pass inspection at point of employment before shipment.

We have no company labor bureaus.

On account of weather conditions, we are unable to keep track men permanently employed, it being necessary to greatly reduce forces during the winter months.

Track laborers are furnished with bunk houses or bunk cars in which to live. Most of our laborers are foreigners and they board themselves. We give no other inducements.

We have no particular method or system in the promotion of track laborers. If laborers remain in the service long enough to enable them to obtain a knowledge of efficient track work, we aim to promote them when capable and vacancies occur.

Our standard of work so far as track labor is concerned, we consider, is in a very fair state of efficiency. Our track maintenance organization is such that the situation is kept well in hand at all times under present methods.

As long as it is necessary for railroads to hire foreign laborers, the overflow of southern Europe and the lowest type of intelligence among the various nationalities represented, it will be difficult to obtain the maximum efficiency. If conditions were such that the railroads could offer more encouragement to intelligent labor in the way of better pay and working conditions, it would induce a much better class of labor to enter the service of the railroads in the roadway department, out of which there would be plenty of material to make foremen and subsequently, efficient roadmasters.

Handling Maintenance Labor on the Pennslyvania

The Pennsylvania road employs all its laborers locally and does not depend upon any particular cities for them. Track laborers are therefore not hired through agencies, either company or private, and there is no track labor bureau.

Every effort is made to keep track men permanently employed, in so far as variation of business and requirements of track up-keep will warrant. It is necessary, however, to reduce the force to a degree in the winter season when certain features of track work cannot be undertaken.

Track laborers are furnished with dwelling houses and comfortable living quarters in localities where they cannot readily obtain such facilities themselves. And bunk houses are provided for temporary occupation where necessities require. No inducement is held out to retain the laborers other than taking good care of the men.

A man is started as laborer, and then promoted to first-laborer, assistant foreman and then foreman, promotions being made from time to time as he evidences the requisite intelligence and ability. With respect to the foreign laborers, there is a system of educating them in the English language and proper use of the track tools and appliances used on the system. Also there is instruction in the manner of performing different features of track work and of protecting themselves and fellow laborers against the dangers involved in this line of work.

The system of instruction consists in issuing pamphlets and papers giving full explanations and descriptions of methods and tools, printed in the several foreign languages necessary to make the instructions clear to all laborers. The examination of the men for promotion is principally upon the maintenance of way book of rules and book of train rules and upon their understanding of the different material used. This system has been giving perfectly satisfactory results and there seems to be no good reason for making a change.

BOOK REVIEWS

"Biographical Directory of the Railway Officials of America," published by Simmons-Boardman Publishing Co.

This 1913 edition, so-called, is the seventh in the series pubished, beginning with 1885. Since the latter date there have appeared editions in 1887, 1893, 1896 and 1906, respectively. The purpose of this directory is to give a concise and accurate record, without embellishment of the railway service of general, divisional and departmental officers; and the seven closely packed volumes constitute an interesting history of change in railway personnel, including promotions, transfers and retirements.

The first issue made up a volume of 276 pages and contained 3,764 names. The 1913 edition comprises 625 pages and contains 4,200 personal histories. In 1885 the railway mileage of the country was but 128,000. Today it is over 245,000. There were 600,000 railway officers and employees in America in 1885, while today this army of faithful workers in the railway field has in its ranks 1,700,000; equal to the standing armies of France and Germany in time of peace. The 1913 edition before us is as complete and full as it can be made and is a book which should be in the hands of every one who is interested in railway affairs. As a book of reference it is invaluable. The price is $4.00, net, and is sold by the McGraw-Hill Book Co., Inc., at 239 West 39th St., New York.

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THE NEW WEBSTER

It may seem strange to say that a dictionary of the English language is very interesting reading, but it is nevertheless quite true. One does not, of course, read with any idea that there is a connected story conveyed by the sequence of words, but each word in the whole book has its own distinct place as a vehicle of expression, and each has its exact shade of meaning, so that no two words are ever precisely alike, and many of them have obscure and curious origins.

The very word "curious," used above, comes from the Latin, meaning careful, and to pursue this theme further, it seems that one of the definitions given in the new "Merriam-Webster" for this word is careful, scrupulous, nice, exact. Nice once meant "ignorant," and is derived from the Latin *ne-sicre,* not to know. It may have arisen from the fact that in former times ignorant persons were easily influenced by the opinions of others, and were pliant, not likely to object or argue the point, and were thus agreeable and pleasant to those who sought to dominate them. Nice, in the sense of exact, refers to fine distinctions which give pleasure.

There is a tendency to spell the words "all right" as one word, and in time this usage may grow. Now, however, the New Webster does not lend its authority for the usage. Gantry comes from *gaun,* a frame for supporting barrels, and *tree* made of wood used with other words like gallows-*tree.* The gantry is originally the gaun tree or wooden frame for supporting barrels or other objects. Hence our use of the word.

When one consider the appropriateness of words, and to be correct we speak of a herd of buffalo, a flock of geese, a covey of grouse and a bevy of larks. Custom or useage has stereotyped these phrases, and a good dictionary is the tabulated record of correct usage.

By the use of this book one acquires a vocabulary, and when we speak in this way we do not mean that any man will become familiar with the 400,000 words defined in Webster's New International Dictionary, as the publishers, C. & G. Merriman Co., call it, but he will without thinking of it absorb in the shades of meaning which the words he reads carry, and he will feel that having made then his own he has enriched his power of speaking and writing and that he rests on authority when he so uses the mother tongue.

The work is exceptionally good on derivation, and the definitions are clear and exact. The pages are divided into two parts, the upper and larger contains the words most "looked up," and the lower gives those less often sought, but all are there. The book contains a Gazeteer of the World. This is a geographical dictionary. There is a Biographical section, and a section on Foreign Phrases. A departure in a new direction is to be seen in the Reference History of the World. A section with special index, and giving 20,000 historical references, is most useful to all classes of users.

It is, as a standard work, primarily a dictionary of the English language, and its bases its authority on the best usage. The dictionary follows the careful work, and the educated and enlightened usage of scholars and writers of repute who are entitled to speak on the subject and to be heard.

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"Annual Report of the Smithsonian Institute for 1914."

This very complete and splendidly illustrated report shows the operations, expenditures and condition of this institution for the year which ended June 30th, 1914. It covers a wide field and shows great care and study on the part of the officers engaged in the work. Published by the Government Printing Office at Washington guarantees the quality of the book as to the paper upon which it is printed and the style of type. Any one fortunate enough to have a copy in his possession will find it a handy reference guide which will engage his close attention when he turns its pages.

SOME INSTRUCTIONS FOR LAYING STEEL RAIL

By C. A. Morse, Chief Engineer Rock Island Lines.

Comprehensive instructions have recently been got out by C. A. Morse, Chief Engineer of the Rock Island Lines, from these instructions tending to produce a similarity of procedure all over the road. We have made some informative extracts.

Rails must be unloaded without being damaged. If rails are in box cars or high-side gondolas, some approved device must be used for unloading, or rails must be transferred on to flat cars or low-side gondolas. When a rail is dropped from the side of one of these cars, care must be taken to see that both ends are dropped at once and striking on hard or uneven surfaces is avoided. Rails to be placed in piles must be unloaded with skids. Where heavier rails or larger tie plates require additional adzing, this must be done, when practicable, by the section men before removal of old rail. Score adz on both sides of rail, cutting to the depth of rail cut or wear, and in a straight line across the face of ties, parallel with rail. The distance of score from base of rail to be governed by size of tie plate or rail to be used.

Before track is obstructed or made unsafe for schedule speed, the work must be protected as provided by the Rules and Regulations of the Operating Department. Track must be lined to new center-stakes before rail is laid. Rails must be laid to line and gauge, one rail at a time and not in strings. Pull three lines of spikes, two inside and one outside, except where metal tie plates are used, when four lines must be pulled. No rail under 15 ft. in length to be used in the main track. Wherever possible, rails not less than 25 ft. in length must be used.

Rails must be laid with broken joints. Joints shall not run by the center of opposite rail to exceed 24-ins. in either direction. Joints should not be less than 10 ft. from the ends of bridges and center of water tanks and cranes, and should be kept, as far as possible, out of street and road crossings and off cattle guards. Before spiking insert all bolts and screw nuts tight, leaving no lip between rail ends. Bolts must be tightened a second time next day after rail is laid and repeated as often as necessary. Standard tie plates must be used on all new creosoted ties in main track where the rail section is 80 lbs. or heavier, including re-rolled rail. Cut spikes will be used with all additional 100-lbs. rails or less. All spikes must be driven vertically with a full hold on the flange close up to the rail base. This should be done by careful driving and not by the last blow of the hammer.

Where screw spikes are to be used, only such preliminary spiking should be done as is absolutely necessary.

Gauge of track is the distance between heads of rails at a point of five-eighths of an inch below the top. Curves of 10 degs. or less must be laid to 4 ft. 8½ ins., and the gauge shall be widened ⅛ in. for every 2 degs. up to 4 ft. 9¼-ins. When rails are laid they must be perfectly lined and surfaced, all new ties put in and old ties straightened and spaced. Expansion to be provided for rails of 34 ft. lengths is as follows: Temp.—Fahr. Minus 20 deg. to zero, allowance 5/16 in.; zero to 25 deg. allowance 1/4 in. 25 to 50 deg. allowance 3/16 in.; 50 to 75 deg. allowance 1/8 in.; 75 to 100 deg. 1/16 in. Over 100 deg. rails should be laid close without bumping.

New rails laid on curves of over 4 degs. must be curved before laying. Particular care must be taken to insure uniform curve throughout its length, in accordance with the following table of middle ordinates:

Middle Ordinates for Curving Rails (In Inches)

Degree of Curve	Length of Rail 16′	18′	20′	22′	24′	26′	28′	30′	33′
4	1/4	3/8	1/2	1/2	5/8	11/16	13/16	15/16	1–1/8
5	3/8	3/8	1/2	5/8	3/4	7/8	1–0	1–3/16	1–7/16
6	3/8	1/2	5/8	3/4	7/8	1–1/16	1–1/4	1–7/16	1–11/16
7	1/2	5/8	3/4	7/8	1–1/16	1–1/4	1–7/16	1–11/16	2–0
8	1/2	3/4	7/8	1–0	1–3/16	1–7/16	1–11/16	1–7/8	2–1/4
9	5/8	3/4	7/8	1–1/8	1–3/8	1–5/8	1–7/8	2–1/8	2–9/16
10	5/8	7/8	1–0	1–1/4	1–1/2	1–3/4	2–1/16	2–3/8	2–13/16
11	3/4	1–0	1–1/8	1–3/8	1–11/16	1–15/16	2–1/4	2–5/8	3–1/8
12	3/4	1–0	1–1/4	1–1/2	1–13/16	2–1/8	2–1/2	2–13/16	3–7/16
13	7/8	1–1/8	1–3/8	1–5/8	1–15/16	2–5/16	2–5/8	3–1/16	3–11/16
14	1–0	1–1/4	1–1/2	1–3/4	2–1/8	2–1/2	2–7/8	3–5/16	4–0
15	1–0	1–1/4	1–5/8	1–7/8	2–1/4	2–11/16	3–1/8	3–9/16	4–1/4

Where the old rail is bonded for automatic signals, crossing bells, interlocking plants, etc., the Division Engineer must notify the Signal Engineer in ample time to provide men and material for the work. Bonding holes should not be drilled far enough in advance of the bonding to permit of corrosion before bonding. Channel pins and bond wires should be kept dry under cover until used. All signal work must be completed and in operation at close of day. Before rail is removed from track it must be calipered for relaying and rerolling. All tangent rail not worn to exceed ⅛-in. should be used as relaying rail, provided it is not kinked or surface bent and the ends are good. All rail that is worn to a depth exceeding ⅛ of an inch.

ORIGIN OF "SAFETY FIRST"

A great deal has been said of the origin of the Safety-First movement. It will interest railroad men to know that the earliest record of systematic eye protection is that of the Crane Company, which in 1897 began to provide eye protectors for their men, and in 1898 put this work on a systematic basis, giving the glasses to the men free of charge and requiring operators, as far as possible at that time, to wear the glasses constantly when exposed to flying bits of metal, emery, dust, glare and hot metal. Dr. A. M. Harvey, who at that time was and still is their chief surgeon, was the originator of this plan of providing glasses for the men, and the fact is that since the company has been providing glasses eye injuries have been reduced to an extremely low point. This proves the value of having workmen protect their eyes in the shops. The company posted signs, placed conspicuously at various points in the shop, drawing the attention of the men to the necessity of using glasses and the fact that the glasses were provided free of charge. The safety movement is thus believed to have been largely due to the originality and activity of Dr. Harvey. From this time on the safety first idea has taken hold strongly on the railway world.

Personal Items for Railroad Men

A. MAS, recently appointed roadmaster of the western division of the Duluth, South Shore & Atlantic Railway, with headquarters at Superior, Wis., succeeds Mr. J. D. Albright, resigned.

F. B. OREN, Superintendent of the Yazoo & Mississippi Valley R. R. on the New Orleans Division, with headquarters at Vicksburg, succeeds Mr. J. W. Meehan, who has left the service.

W. L. BRADLEY, Division Engineer, A. T. & S. F. Ry., Fresno, transferred to Needles; vice Mr. W. H. Oliver transferred to San Bernardino; vice Mr. M. C. Bryan transferred to Winslow; vice Mr. E. E. Ball, transferred to Fresno.

J. W. JONES has recently been appointed Superintendent of the Western Division of the Wabash R. R., with offices at Moberly, Mo. This position has been created by the combination of the lines between Moberly and Kansas City; Brunswick and Omaha; and Glasgow Branch and Excelsior Springs Branch, to be operated as the Western Division.

F. C. HUNTINGTON, recently appointed Superintendent of the Fargo Division of the Northern Pacific R. R. at Dilworth, Minn., succeeds F. R. Bartles, transferred to the Minnesota Division, with headquarters at Staples, Minn. T. F. Lowrey, whom Mr Bartles succeeds at Staples, has been appointed Superintendent of the Rocky Mountain Division, with headquarters at Missoula, Mont., succeeding F. L. Birdsall, resigned.

F. G. COOK, recently appointed Roadmaster of the Northern Pacific R. R., with headquarters at Mandan, N Dak., graduated from Dartmouth College in 1908, Thayer School of Civil Engineering in 1910; started work immediately after graduating, for the Northern Pacific R. R. in the Engineering Department, as rodman, instrument man and assistant engineer, holding the last position for three years, with headquarters at Jamestown, N. Dak.

J. B. WILSON, recently made Roadmaster of the M. K. & T., has in the last five years acted as lamp inspector, tie inspector, has had charge of work trains and extra gangs, storage of coal, and in 1913 was appointed Acting Roadmaster of the Hillsboro and Fort Worth divisions. In 1914 Mr. Wilson became general foreman of the Waco-Bellmead Terminal and now succeeds Mr. T. F. Sharp, since appointed Resident Engineer of the Smithville District, as Roadmaster, Waco to Cross Plains, with headquarters at Waco.

E. T. WHITER, recently appointed Assistant General Manager of the Pennsylvania Lines west of Pittsburgh, with office in Pittsburgh, was born at Steubenville, Ohio, in 1864, and his entire railroad service has been with the Pennsylvania Lines west of Pittsburgh. Mr. Whiter first entered railroad service in 1881 as Telegraph Operator and served consecutively as Telegraph Operator, Train Dispatcher, Assistant Train Master and Train Master until 1903, when he was appointed Superintendent of the Eastern Division. In 1913 he was appointed General Superintendent of the Northwest System of the Pennsylvania Lines, which position he held until his recent appointment as Assistant General Manager of the Pennsylvania Lines West.

Prior to his appointment as Assistant General Manager there was no such office.

M. C. BLANCHARD, recently appointed engineer of the eastern district of the Atchison, Topeka & Santa Fe Railway, with offices at Topeka, Kan., entered the service of the Santa Fe in 1901, and was employed as general man, rodman, draftsman and instrument man in various locations until, in 1905, he was made assistant engineer in charge of double-track work. In 1907 he was made division engineer of the Kansas City division, and two months later was transferred to the middle division. In 1909 he was appointed roadmaster of the middle division, and in 1910 assigned to special work in the chief engineer's office. In 1911 Mr. Blanchard became division engineer of the eastern division, and in 1913 became office engineer in the chief engineer's office, where he remained until he succeeded Mr. J. M. Meade, assigned to valuation work.

EDWARD A. EVERETT, formerly signal engineer of the Michigan Central, has opened an office at 50 Church street, New York, for the sale of railway supplies and signal material. He represents the Hobart-Allfree Company, Chicago, derailers and car replacers; E. J. Clark, Philadelphia, Pa., T. C. Cypress Trunking and Capping; the National Concrete Machinery Company, Madison, Wis., concrete fence post machinery and supplies; the Detroit Twist Drill Company, Detroit, Mich., high-speed bonding drills; the J. Frederick Schroeder Hair Felt Company, Newark, N. J., high-grade hair felt used in refrigerator car construction, steam pipe covering and as a cushion under relays and electrical apparatus; The Track Necessities Co., Chicago, tie tongs; the Cincinnati Electrical Tool Company, Cincinnati, Ohio, portable electric drills, grinders and reamers; the Keller Pneumatic Tool Company, pneumatic drills, hammers, riveters and chippers; the Reliable Electric Company, Chicago, signal, telephone and telegraph specialties. Mr. Everett also has charge of the sales of the electric release train annunciator which is one of his patents and which has been sold for several years by the Railroad Supply Company, Chicago. He also has a line of copper clad and bond wires and high strength non-corrosive bond wire.

LOUIS T. SHANNON, of Pittsburgh, Pa., and ROBERT R. LITEHISER, of Eaton, Ohio, are announced by the general managers of the Pennsylvania Lines East and West of Pittsburgh as the winners of the Frank Thomson scholarships for 1915. The Frank Thomson scholarships were established in 1907 by the children of the late Frank Thomson, formerly president of the Pennsylvania Railroad, as a memorial to their father. The scholarships are awarded each year, upon competitive examination, to sons of living or deceased employes of the Pennsylvania Railroad system. There were twenty-three applicants this year. The purpose of the Frank Thomson scholarships is to enable the holders to take technical college courses to fit themselves for entering the service of the Pennsylvania Railroad. Mr. Shannon is the son of William T. Shannon, deceased, who was an engineman on the Conemaugh division. He prepared for college at the Fifth Avenue High School, Pittsburgh, and intends entering the Carnegie Institute of Technology, Science Department, in the fall. Mr. Litehiser is the son of Daniel R. Litehiser, telegraph operator on the Southern division of the Grand Rapids & Indiana Railway. He received his preliminary education at the Eaton, Ohio, High School, and expects to enter the Scientific Department of Harvard University.

WASHOUTS

By T. F. Stewart.

When a washout occurs flagmen should be sent out immediately and a report wired to the proper officials, giving the location and extent of damage, as well as the material which will be required for repairs. The foreman should immediately do whatever he can with the means and material at hand to make repairs and prevent further damage. A fully equipped pile driver should always be kept on a division, and the bridge gang should be sent out promptly with tools necessary for redriving and placing false work, or whatever the circumstances require. If the banks are being washed out, this may be checked by covering them with stone, brush mattress or rough cribbing. It is generally useless to try to fill a gap with anything but stone, if there is a current flowing through it. If the water is too high or too turbulent to allow commencing the repair work at once the time may be spent in collecting material, building trestle bents, filling sacks with sand or earth, and getting material for cribbing, etc.

A pile driver is most necessary where bad washouts occur, and should be kept in readiness for immediate work during the wet season. The pile driver should be large enough so that it can build 15 ft. bents; then the piles may be driven, the deck put on and the pile driver immediately moved ahead over the new section. A flat car should be kept next to the pile driver, equipped with a 20-ton hydraulic jack, 6 screw jacks, 2 snatch blocks for 2 in. line and 2 for 1½ in. line, 3 sets of blocks and falls for 1 in., 1½ in. and 1½ in. line; also 600 ft. of 1¾ in. rope, carpenters' tools and a supply of bars, wrenches, chains, hauling lines, spikes, nails, etc. There should also be on this flat car a coal bunker and a 2,000 gal. water tank. About 24 men are required with the pile driver when doing emergency work, 8 of these being laborers, and the others bridge men, and the crew of the pile driver itself consisting of an engineman and fireman. This equipment is capable of driving 5 bents of 4 piles each, completing the floor and track in 10 hrs.

If a temporary trestle is required, piles may be driven, cut off to height and connected by caps drift-bolted in the usual way. If a pile driver is not available, a hand derrick or a gin pole may be used to handle piles, timbers or framed bents. Two piles may be "jumped" and churned by means of ropes to sink them into the bed, and then may be secured to each other by plank braces. The planks then serve to guide the additional piles. It is not necessary to get the piles evenly spaced when using this method. Another method which can be used where there is hard bottom is to make soundings for each leg of the bent, cut the posts to length, connect them by a drift bolted cap, a 3x10 in. diagonal brace and a 4x10 in. horizontal plank at what will be the water line. These bents can then be placed in position and connected by longitudinal bracing. With a rocky bottom and a swift current holes may be drilled and light charges of dynamite used to enlarge the holes to receive the large ends of the piles. The dynamiting is accomplished by using a block nailed to the batter pile through a hole in which a 2 in. gas pipe is placed. The batter pile is then set down and a hole drilled by working through the gas pipe sleeve. A hole is drilled in the rock for a 1½ in. anchor bolt and the pile is anchored to it.

If the channel is wide, rafts or boats may be used held by lines. From these the men can guide the piles into the desired position and put in horizontal braces at the water line. Joists or round timbers 32 ft. long, chained to the last bent, may be run out over the ledger boards and a few planks laid on these for the men to use in carrying out posts for the bent ahead. Sighting over the ledger boards gives the level for cutting off the posts for the caps.

All bridges, trestles, drains and waterway should be inspected by the head of the department at least twice a year. First, for maintenance to see if they are in proper condition, and second, for renewals to ascertain what is needed for replacement, repairs, etc. Annual inspection may suffice where bridges, etc., are modern and of ample capacity, but old timber trestles should be watched very closely. Special reports should be made upon all repairs, renewals, or construction as soon as completed.

The bridge inspector should be familiar with every detail of the work, particularly bridge design and trestles. He should be furnished with a list of bridges to be inspected where a special inspection is desired. The bridge inspectors should be chosen on account of their fitness for the position, and should be consulted with freely in regard to the condition of bridges under their care. Where a special inspection is desired a list indicating which structures require special watching should be made up. Reports are usually made on printed forms bound in a book of pocket size.

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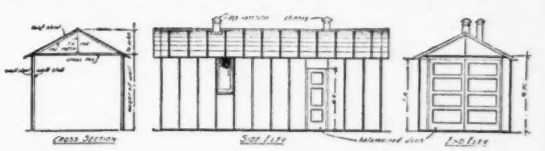

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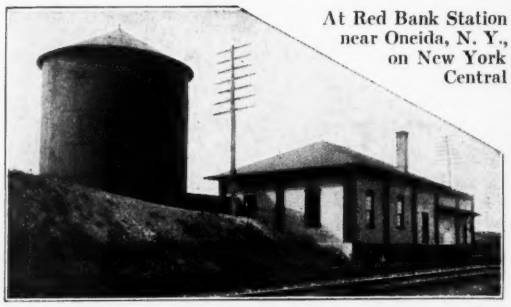

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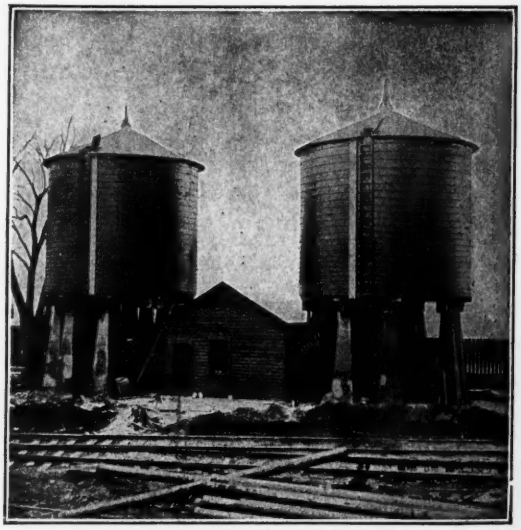

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